

# BMJ Open

BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (<http://bmjopen.bmj.com>).

If you have any questions on BMJ Open's open peer review process please email [info.bmjopen@bmj.com](mailto:info.bmjopen@bmj.com)

# BMJ Open

## Impact of the test and treat policy on delays in ART initiation among HIV positive patients in Johannesburg, South Africa

|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Journal:                      | <i>BMJ Open</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Manuscript ID                 | bmjopen-2019-030228                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Article Type:                 | Research                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Date Submitted by the Author: | 20-Mar-2019                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Complete List of Authors:     | Onoya, Dorina; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office<br>Sineke, Tembeka; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office<br>Hendrickson, Cheryl; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office<br>Mokhele, Idah; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office<br>Maskew, Mhairi; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office<br>Long, Lawrence; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office; Boston University, Boston School of Public Health, Department of Global Health<br>Fox, Matt; Boston University, Epidemiology and Global Health; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office |
| Keywords:                     | HIV & AIDS < INFECTIOUS DISEASES, Public health < INFECTIOUS DISEASES, PRIMARY CARE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

SCHOLARONE™  
Manuscripts

**+Working Title:**

Impact of UTT and same-day-ART treatment initiation policies delays in ART initiation in Johannesburg, South Africa

**Title: Impact of the test and treat policy on delays in ART initiation among HIV positive patients in Johannesburg, South Africa**

**Authors:** Dorina Onoya<sup>1</sup>, Tembeka Sineke<sup>1</sup>, Cheryl Hendrickson<sup>1</sup>, Idah Mokhele<sup>1</sup>, Mhairi Maskew<sup>1</sup>, Lawrence Long<sup>1,2</sup>, Matthew P. Fox<sup>1,2,3</sup>

<sup>1</sup> Health Economics and Epidemiology Research Office, Department of Internal Medicine, School of Clinical Medicine, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa

<sup>2</sup> Department of Global Health, Boston University School of Public Health, Boston, MA, USA

<sup>3</sup> Department of Epidemiology, Boston University School of Public Health, Boston, MA, USA

**Corresponding author:** Dorina Onoya, Health Economics and Epidemiology Research Office, 39 Empire Road, Parktown, Johannesburg, 2193, South Africa, [donoya@heroza.org](mailto:donoya@heroza.org) +27 10 001 7930

**Keywords:** HIV, ART attrition, UTT, same-day-ART

**Word count (main body):** 2074

## Abstract

**Objectives** To assess delays to antiretroviral therapy (ART) initiation before the Universal Test & Treat (UTT) policy, under UTT and during Same-day-ART policy periods in Johannesburg (South Africa).

**Design** Prospective cohort study

**Setting** Patients were recruited from six primary health clinic in Johannesburg.

**Participants** Overall, 1029 newly diagnosed HIV positive adults ( $\geq 18$  years) were enrolled between April to December 2015 (Pre-UTT), July-September 2017 (UTT) and October 2017-July 2018 (UTT/Same-day-ART).

**Main outcome measures** Patient records were reviewed 30 days after HIV diagnosis. Predictors of 30-days-ART initiation were assessed using Cox proportional hazards models. Additionally, predictors of Same-day-ART initiation were evaluated using Poisson Regression modelling.

**Results** Overall, 740 (71.9%) initiated ART within 30 days (36.9% pre-UTT, 65.9% under UTT and 79.9% under UTT/Same-day-ART). The median days to ART initiation declined from 21.0 days pre-UTT (IQR: 15-30) to eight days (IQR: 6-16) under UTT and five days (IQR: 0-8) under the UTT/Same-day-ART policy. However, only 150 (20.2%) of the UTT/Same-day-ART cohort initiated ART immediately. Living in a two-adult home (adjusted Hazard ratio (aHR) 1.2 vs living alone, 95% Confidence Interval (CI): 1.0-1.4) and travelling >30 minutes to the clinic (aHR 1.3 vs. <15 minute travel, 95% CI: 1.1-1.7) were associated with a higher likelihood of starting ART within 30 days. Participants who lacked 30-days CD4 data were 30% less likely to start ART by 30 days (aHR 0.7 vs CD4<350 cell/ $\mu$ l, 95% CI: 0.6-0.8). The opposite was true for immediate ART initiation among the UTT/Same-day ART cohort (aRR 1.7 for missing vs CD4<350 cell/ $\mu$ l, 95%CI: 1.3-2.4).

## Conclusions

Our results highlight a move towards earlier initiation of HIV treatment after the “treat all” policy implementation. However, increases in missing a baseline laboratory data and the low

1  
2  
3 implementation/uptake of immediate ART highlights potential health infrastructure and human  
4 resources limitation critical for sustained policy implementation.  
5  
6

7 **Word count: 350**  
8  
9

## 10 11 12 **Strengths and limitations** 13

- 14 • Cohorts enrolled across the three most recent ART guideline implementation periods in  
15 South Africa, allowing observation of changes over time.  
16
- 17 • Cohorts enrolled immediately after HIV diagnosis, allowing for observation of ART  
18 initiation and early losses from HIV diagnosis.  
19
- 20 • Our results highlight a positive move towards earlier initiation of HIV treatment after the  
21 “treat all” policy implementation.  
22
- 23 • Although a significant reduction in delays to ART initiation has been achieved, ART  
24 initiation on the day of HIV diagnosis is proving more challenging and may require  
25 additional resources.  
26
- 27 • Increases in missing laboratory tests at diagnosis reduce the strength of laboratory datasets as  
28 monitoring tools for the early steps of the HIV treatment cascade and estimation of the  
29 impact of the Same-Day ART on patient CD4 profile at diagnosis.  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## Introduction

South Africa has the largest HIV epidemic in the world, with an estimated 7.9 million people living with HIV, with an ART program covering an estimated 4.4 million (55.7%) HIV infected patients by 2017(1).

In September 2016, South Africa adopted the World Health Organization (WHO) 2015 Universal Test and Treat (UTT) policy making all HIV positive patients eligible for antiretroviral therapy (ART) at diagnosis, irrespective of CD4 count (2-4). South Africa's adoption of the UTT policy was based on the availability of safer, more tolerable drug combinations and reliable evidence of the positive impact of early ART initiation on several treatment outcomes (5-7). Compared to those who deferred treatment, patients who started ART immediately after HIV diagnosis had lower rates of AIDS-related adverse events and improved viral suppression rates with no difference in post-initiation attrition rates (8, 9). Additionally, this "treat all" strategy was also supported by substantial evidence of ART as an HIV prevention strategy (7, 10).

In 2017, the UTT policy in South Africa was updated with a directive to initiate ART on the day of HIV diagnosis (Same-day-ART) (11). While widespread support for the "treat all" policy has created momentum for its promulgation, there remain reservations that health system capacity constraints may limit same-day-ART policy assimilation and result in variations in implementation at facility-level (12). The policy was implemented amid concerns that, under UTT, health facilities in high burden settings, in particular, might struggle with the increased patient burden, potentially reducing the quality of care provided to new and existing patients (13-15). Recent studies show that the implementation of same-day-ART policy is challenged by limited health personnel and infrastructural capacity (13, 16, 17). PHC-level health care providers also raised concern around patient acceptance of same-day-ART, ART refusal or early patient disengagement from care or intermittent adherence after starting ART (18).

The 2017 National HIV survey in South Africa reported welcome increases in the number of HIV positive patients initiated on ART (nearly one million additional patients have been initiated between 2016 and 2017 (3). However, in addition to measuring the program success in expanding access to ART, critical outcomes of the UTT policy and associated interventions are the initiation of relatively asymptomatic individuals on ART, reductions in delays to ART initiation and long-term retention in HIV care.

1  
2  
3 In this study, we set out to measure the impact of UTT and same-day-ART policies on time to  
4 ART initiation and to examine factors associated with initiating ART within 30 days of HIV  
5 diagnosis across the three recent ART guideline periods in Johannesburg, South Africa.  
6  
7  
8  
9  
10

## 11 **Methods**

### 12 *Study Setting and design*

13  
14 This study was conducted at six peri-urban primary healthcare clinics (PHCs) in Johannesburg,  
15 South Africa. We conducted a prospective cohort study, enrolling consenting newly diagnosed  
16 HIV positive adult ( $\geq 18$  years) patients from April to December 2015 (Pre-UTT), July-  
17 September 2017 (UTT, before same-day-ART) and October 2017-July 2018 (UTT/Same-day-  
18 ART). UTT and UTT/Same-day-ART cohorts were only enrolled from two primary health  
19 clinics (PHCs) in Johannesburg while the UTT/Same-day-ART cohort included four additional  
20 PHCs in Johannesburg. Participant enrolment co-occurred across sites until the total sample size  
21 was attained. All patients were enrolled in the study by trained study interviewers via referral  
22 from PHC-based lay HIV counsellors. Patients were eligible if they had initiated HIV care after  
23 diagnosis. Women who were pregnant at HIV diagnosis were excluded from the study because  
24 their in-pregnancy treatment initiation and care processes differ from that of non-pregnant  
25 women.  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35

### 36 *Data Collection*

37  
38 Consenting patients completed an interviewer-administered baseline questionnaire after HIV  
39 testing, on the day of HIV diagnosis. The interview included questions on demographic factors,  
40 socio-economic status and health-seeking behaviour. Patients were passively followed up for 30  
41 days to determine ART initiation. Routine clinical follow-up data were collected from paper and  
42 electronic medical records including laboratory test results.  
43  
44  
45  
46  
47

### 48 *Patient and Public Involvement*

49  
50 Patients were not directly involved in the design of this study. However information collected  
51 from patients in previous studies informed the design, data collection approaches and  
52 interpretation of study results. Also, the study implementation was guided by health care workers  
53 form participating study sites. Study participants consented to a once-off direct data collection  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 after HIV diagnosis and passive follow-up data collection via medical record review. Therefore  
4 direct result dissemination to patients will not be possible. However we plan to present study  
5 results to health care workers and policy-makers at participating PHC clinics and at other policy-  
6 relevant forums.  
7  
8  
9

### 10 *Outcome data and analysis*

11  
12 The primary exposure variable was the HIV testing guidelines at the time of HIV diagnosis  
13 categorised as pre-UTT, under UTT but before the same-day ART policy (UTT) and after the  
14 same-day ART cohort (Same-day-ART). The outcome event was ART initiation within 30 days  
15 of HIV diagnosis. Patients were followed up from the date of HIV diagnosis to ART initiation in  
16 the first 30 days of HIV care, time of transfer/ death if these occurred in the first 30 days, at 30  
17 days after HV diagnosis if there was no evidence of transfer or death (patient assumed to be  
18 returning).  
19  
20  
21  
22  
23  
24

25 Predictors of ART initiation in the first 30 days of HIV care were assessed using Cox  
26 proportional hazards models, reporting Hazard Ratios (HR). Additionally, predictors of ART  
27 initiation on the day of HIV diagnosis were evaluated using Poisson Regression modelling,  
28 reporting Relative Risks (RR). The study protocol was reviewed and approved by the  
29 Institutional Review Boards of the University of Witwatersrand (M141103) and Boston  
30 University (H-33516).  
31  
32  
33  
34  
35  
36  
37  
38

## 39 **Results**

### 40 *Clinical and demographic characteristics at baseline*

41  
42 The study sample consisted of 1029 adults enrolled immediately after HIV testing, 146 (14.2%)  
43 enrolled in the pre-UTT period, 141 (13.7%) under UTT but before the same-day ART directive,  
44 742 (72.1%) under the UTT/same-day ART policy (Table 1, Figure 1). The age and gender  
45 distributions of participants were similar across cohorts. Although the proportion of participants  
46 who tested with CD4 count < 350/mm<sup>3</sup> decreased from 65.8% pre-UTT to 39.7% in the  
47 UTT/Same-day-ART cohort, the percentage of patients with missing 30 days (baseline) CD4  
48 count results increased from 3.4% to 34.7%. The proportion of patient with 30 days CD4  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



count > 500 cells/ $\mu$ l did not change substantially across guideline periods (13.5% pre-UTT, 18.1% UTT and 20.0% Same-day-ART).

The majority of participants (72.9%) had less than a grade 12 qualification but, overall, 52.5% were employed. Most participants lived within 15 minutes of the diagnosing clinic (56.9%). However, a small proportion reported travelling over 30 minutes to reach the clinic (12.5% overall, 6.8% pre-UTT, 4.3% under UTT and 15.2% under the Same-day-ART policies).

#### *Time to ART initiation from HIV diagnosis across guideline periods*

The overall median days to ART initiation declined from 21 days (IQR: 15-30) to a median of 8 days (IQR: 6-16) after the implementation of the UTT policy and was further reduced to 5 days (IQR: 0-8) after the same-day-ART directive was given (Figure 2). Overall, 71.9% initiated ART within 30 days of HIV diagnosis, 36.9% pre-UTT, 65.9% under UTT and 79.9% under the Same-day-ART periods (Figure 3). Pre-UTT participants were 80% less likely to initiate ART in the first 30 days (adjusted HR (aHR) 0.2, 95% CI: 0.2-0.3) compared to Same-day-ART participants (Table 2). Similarly, patients diagnosed under the UTT policy were 40% less likely to start ART within 30 days of HIV diagnosis (aHR 0.6, 95% CI: 0.5-0.7) compared to UTT/Same-day-ART participants. There was no meaningful difference in the likelihood of 30 days ART initiation across gender and baseline CD4 categories (among those with CD4 data). However, compared to patients with baseline CD4 < 350 cell/mm<sup>3</sup>, participants who were missing 30 days CD4 counts were 30% less likely to start ART within a month (aHR 0.7, 95% CI: 0.6-0.8). While only 12.5% of participants indicated travelling for at least 30 minutes to the clinic, they were 30% more likely to start ART within 30 days compared to those who travelled no more than 15 minutes (aHR 1.3 overall, 95% CI: 1.1-1.7).

#### *Demographic and clinical characteristics associated with immediate ART initiation within the Same-day-ART cohort*

Among UTT/Same-day-ART participants, 150 (20.2%) initiated treatment on the day of HIV diagnosis (25.3% of those who initiated within 30 days). Older participants (aRR 0.6 for  $\geq$ 40 years compared to 18-29.9 years, 95% CI: 0.4-0.9) were less likely to start ART on the day of

1  
2  
3 HIV testing (Table 3). However, in the Same-day-ART period, missing baseline CD4 data was  
4 associated with a 70% higher likelihood of starting ART on the day of HIV diagnosis (aRR 1.7,  
5 95%CI: 1.3-2.4). Although not included in the multivariable model, we also describe a high  
6 variability in same-day-ART policy implementation across sites (Table 4).  
7  
8  
9

## 10 11 12 13 **Discussion**

14 This study highlights a marked reduction in time to ART initiation before the UTT guidelines  
15 and after the same-day-ART policy implementation. The most substantial decline in time to  
16 ART occurred immediately after September 2016 policy change (from 21 to 8 days) when the  
17 “treat all” policy, which did not include a directive to modify ART initiation processes begun,  
18 with additional declines (to 5 days) in delays to ART start after the same-day-ART  
19 memorandum was sent to clinics. These declines are consistent with the goals of the WHO HIV  
20 treatment guidelines: to initiate patients as early as possible to achieve better clinical outcomes  
21 (2-4).  
22  
23  
24  
25  
26  
27  
28

29 Consistent with previous findings, we found that the majority of patients still present with low  
30 CD4 counts ( $<350$  cell/mm<sup>3</sup>) (19), with under 10% increase in the proportion of patients  
31 presenting at CD4  $>500$  cells/mm<sup>3</sup> after UTT. These results highlight the need for consistent  
32 efforts to increase early HIV testing and ART initiation of asymptomatic as well as older male  
33 patients. We also observed a substantial increase in the proportion of patients who lacked  
34 baseline CD4 data. For the 30-days-ART outcome, having a missing baseline CD4 was  
35 associated with a reduced likelihood of starting ART, suggesting that before the UTT policy, the  
36 lack of baseline CD4 was synonymous of early loss from care. However, under the UTT/Same-  
37 day-ART policy, missing baseline CD4 data may indicate changes in clinic processes to  
38 accommodate the faster ART initiations. This missing data could result from clinic deferral of  
39 blood draws (for late initiations/ past blood collection times) or patient impatience with the  
40 drawn-out ART initiation processes on the day of testing.  
41  
42  
43  
44  
45  
46  
47  
48  
49

50 Nearly nine months after the same-day-ART directive, only 20.2% of diagnosed patients under  
51 this policy had started ART on the day of diagnosis, highlighting possible facility-level policy  
52 implementation challenges. We found marked variability in the buy-in of health care workers  
53 and the application of the same-day ART policy across health facilities (20). Healthcare  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 providers expressed reservations about the acceptability of immediate ART for the majority of  
4 their patients and the feasibility of the strategy considering their current workload (20).  
5  
6

7 Interestingly, participants who travelled over 30 minutes to the diagnosing clinic were more  
8 likely to initiate ART on the day of diagnosis, suggesting that motivated patients were willing to  
9 travel further to clinics perceived to offer a better quality of services (21). Furthermore, younger  
10 (<39 years) people may be more informed and see fewer cultural barriers to HIV disclosure and  
11 HIV treatment (21).  
12  
13  
14  
15

16 The strength of the analysis lies in the three prospective cohorts spanning three ART guideline  
17 periods in South Africa, allowing direct observation of the changes in ART uptake and treatment  
18 outcomes over time. However, the study data is limited by the small number of health facilities  
19 assessed and limited information about additional facility level interventions as well as  
20 contributions by partner organisations in supporting policy assimilation and implementation.  
21 Therefore, other data from a more comprehensive facility survey is needed to better explain the  
22 facility-level variations in same-day-ART policy implementation and outcomes. Additionally,  
23 we only collected ART initiation data from testing facilities and were not able to determine if  
24 some participants had started ART elsewhere. The reason for the higher ART uptake among  
25 UTT/Same-day-ART participants require further exploration into ART initiation processes and  
26 their potential impact on patient health-seeking behaviour as well as long term on-ART  
27 outcomes.  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40

## 41 **Conclusion**

42 Our results highlight a positive move towards earlier initiation of HIV treatment after the “treat  
43 all” policy implementation. However, the results also emphasise a vital need to streamline  
44 processes to increase same-day-ART implementation/uptake but also ensure that baseline safety  
45 and monitoring blood tests are done timeously. Going forward, the need to improve patient  
46 demand for early HIV testing remains pertinent to achieving the prevention and treatment  
47 benefits of ART. However, clinic-level infrastructural interventions and human resource support  
48 are needed to ensure sustained policy implementation and patient outcomes.  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## Acknowledgements

We extend our gratitude to the Directors and staff of Primary Health Care Clinics who supported the implementation of the study and our sincere thanks go to the patients attending these clinics for their willingness to participate and share the valuable information that made this study possible.

## Author Contributions

DO and MPF had the original idea for the study and paper. TS managed the study implementation and conducted the primary data analysis. TS, CH, IM, implemented the study and contributed to the result interpretation. LL and MM contributed to the results interpretation. All authors wrote the results and the discussion. All authors reviewed and approved the manuscript.

## Conflict of Interest

Authors have no conflicts of interest to declare.

## Funding

This study has been made possible by the generous support of the American People and the President's Emergency Plan for AIDS Relief (PEPFAR) through United States Agency for International Development (USAID) under the terms of Cooperative Agreements AID-674-A-12-00029 and 72067419CA00004 to HE2RO. The contents are the responsibility of the authors and do not necessarily reflect the views of PEPFAR, USAID or the United States Government.

## Data Statement

Patient medical records are owned by the study site and the National Department of Health (South Africa) and governed by the Human Research Ethics Committee (University of

1  
2  
3 Witwatersrand, Johannesburg, South Africa). All relevant data is included in the paper. The full  
4 data are available from the Health Economics and Epidemiology Research Office for researchers  
5 who meet the criteria for access to confidential data and have approval from the owners of the  
6 data ([information@heroza.org](mailto:information@heroza.org) ).  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

For peer review only

## References

1. HSRC. The Fifth South African National HIV Prevalence, Incidence, Behaviour and Communication survey, 2017: HIV Impact Assessment Summary Report. Cape Town, HSRC Press.; 2017.
2. Abuelezam N N, McCormick AW, Fussell T, Afriyie AN, Wood R, DeGruttola V, et al. Can the Heterosexual HIV Epidemic be Eliminated in South Africa Using Combination Prevention? A Modeling Analysis. *American journal of epidemiology*. 2016;184(3):239-48.
3. Eaton JW, Johnson LF, Salomon JA, Bärnighausen T, Bendavid E, Bershteyn A, et al. HIV Treatment as Prevention: Systematic Comparison of Mathematical Models of the Potential Impact of Antiretroviral Therapy on HIV Incidence in South Africa. *PLOS Medicine*. 2012;9(7):e1001245.
4. South African National Department of Health (South Africa). Implementation of Universal Test and Treat Strategy for HIV positive patients and differentiated care for stable patients 2016. Pretoria: National Department of Health 2016.  
<https://sahivsoc.org/Files/22%208%2016%20Circular%20UTT%20%20%20Decongestion%20CCMT%20Directorate.pdf>  
Accessed October 2018
5. Group TAS, Danel C, Moh R, Gabillard D, Badje A, Le Carrou J, et al. A Trial of Early Antiretrovirals and Isoniazid Preventive Therapy in Africa. *The New England journal of medicine*. 2015;373(9):808-22.
6. Lundgren JD, Babiker AG, Gordin F, Emery S, Grund B, Sharma S, et al. Initiation of Antiretroviral Therapy in Early Asymptomatic HIV Infection. *N Engl J Med*. 2015;373(9):795-807.
7. Rosen S, Maskew M, Fox MP, Nyoni C, Mongwenyana C, Maletse G. Initiating Antiretroviral Therapy for HIV at a Patient's First Clinic Visit: The RapIT Randomized Controlled Trial. 2016;13(5):e1002015.
8. INSIGHT START Study Group, Lundgren JD, Babiker AG, et al. Initiation of Antiretroviral Therapy in Early Asymptomatic HIV Infection. *New England Journal of Medicine*. 2015;373(9):795-807.
9. Rosen S, Maskew M, Fox MP, Nyoni C, Mongwenyana C, Maletse G, et al. Initiating Antiretroviral Therapy for HIV at a Patient's First Clinic Visit: The RapIT Randomized Controlled Trial. *PLoS Med*. 2016;13(5):e1002015.

10. Long LC, Maskew M, Brennan AT, Mongwenyana C, Nyoni C, Malete G, et al. Initiating antiretroviral therapy for HIV at a patient's first clinic visit: a cost-effectiveness analysis of the rapid initiation of treatment randomized controlled trial. *Aids*. 2017;31(11):1611-9.
11. South African National Department of Health (South Africa). Tracking implementation of the 90-90-90 strategy for HIV, through the implementation of Test and Treat (TT) policy and same-day anti-retroviral therapy (ART) initiation for HIV positive patients 2017. Pretoria: National Department of Health; 2017.
12. Onoya D, Mokhele I, Sineke T, Ngoma B, Moolla A, Vujovic M, Bor J, Langa J, Fox M P. Health provider perspectives on implementation of same-day ART initiation six months after policy change in South Africa. International AIDS Conference (poster); 2018; Amsterdam.
13. Boyer S, Iwuji C, Gosset A, Protopopescu C, Okesola N, Plazy M, et al. Factors associated with antiretroviral treatment initiation amongst HIV-positive individuals linked to care within a universal test and treat programme: early findings of the ANRS 12249 TasP trial in rural South Africa. *AIDS Care*. 2016;28(sup3):39-51.
14. Collins S, Geffen N. Community views: balancing the public health benefits of earlier antiretroviral treatment with the implications for individual patients – perspectives from the community. *Current Opinion in HIV and AIDS*. 2014;9(1):4-10.
15. Kulkarni SP, Shah KR, Sarma KV, Mahajan AP. Clinical Uncertainties, Health Service Challenges, and Ethical Complexities of HIV “Test-and-Treat”: A Systematic Review. *American Journal of Public Health*. 2013;103(6):e14-e23.
16. Cassim N, Coetzee LM, Schnippel K, Glencross DK. Estimating Implementation and Operational Costs of an Integrated Tiered CD4 Service including Laboratory and Point of Care Testing in a Remote Health District in South Africa. *PLoS ONE*. 2014;9(12):e115420.
17. Skhosana M, Reddy S, Reddy T, Ntoyanto S, Spooner E, Ramjee G, et al. PIMA TM point-of-care testing for CD4 counts in predicting antiretroviral initiation in HIV-infected individuals in KwaZulu-Natal, Durban, South Africa. *Southern African Journal of HIV Medicine*. 2016;17(1).
18. Bigna JJR, Plottel CS, Koulla-Shiro S. Challenges in initiating antiretroviral therapy for all HIV-infected people regardless of CD4 cell count. *Infectious Diseases of Poverty*. 2016;5(1):85.

- 1  
2  
3  
4  
5 19. Siedner MJ, Ng CK, Bassett IV, Katz IT, Bangsberg DR, Tsai AC. Trends in CD4 count  
6 at presentation to care and treatment initiation in sub-Saharan Africa, 2002-2013: a meta-  
7 analysis. *Clinical infectious diseases: an official publication of the Infectious Diseases*  
8 *Society of America*. 2015;60(7):1120-7.  
9  
10  
11 20. Onoya D, Mokhele I, Sineke T, Ngoma B, Vujovic M, Langa J, et al., editors. Health  
12 provider perspectives on implementation of same day ART initiation six months after  
13 policy change in South Africa. *AIDS* 2018; 2018; Amsterdam.  
14  
15  
16 21. Human Sciences Research Council (HSRC). *The People Living With HIV Stigma Index:*  
17 *South Africa 2014*. HSRC Press: 2014 Accessed October 2018  
18 [http://www.stigmaindex.org/sites/default/files/reports/Summary-Booklet-on-Stigma-](http://www.stigmaindex.org/sites/default/files/reports/Summary-Booklet-on-Stigma-Index-Survey%20South%20Africa.pdf)  
19 [Index-Survey%20South%20Africa.pdf](http://www.stigmaindex.org/sites/default/files/reports/Summary-Booklet-on-Stigma-Index-Survey%20South%20Africa.pdf)  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



**Table 1: Characteristics of the sample population by Period of HIV testing**

|                                      | Pre-UTT<br>(n=146) | UTT<br>(n=141) | UTT/Same-<br>day-ART<br>(n=742) | Total<br>(n=1029) |
|--------------------------------------|--------------------|----------------|---------------------------------|-------------------|
|                                      | n (%)              | n (%)          | n (%)                           | n (%)             |
| <b>Facility</b>                      |                    |                |                                 |                   |
| PHC1                                 | 68 (46.6)          | 72 (51.1)      | 80 (10.8)                       | 220 (21.4)        |
| PHC2                                 | 78 (53.4)          | 69 (48.9)      | 51 (6.9)                        | 198 (19.2)        |
| PHC3                                 | -                  | -              | 207 (27.9)                      | 207 (20.1)        |
| PHC4                                 | -                  | -              | 125 (16.8)                      | 125 (12.1)        |
| PHC5                                 | -                  | -              | 151 (20.4)                      | 151 (14.7)        |
| PHC6                                 | -                  | -              | 128 (17.3)                      | 128 (12.4)        |
| <b>Sex</b>                           |                    |                |                                 |                   |
| Female                               | 87 (59.6)          | 81 (57.4)      | 461 (62.1)                      | 629 (61.1)        |
| Male                                 | 59 (40.4)          | 60 (42.6)      | 281 (37.9)                      | 400 (38.9)        |
| <b>Age, (median, IQR)</b>            |                    |                |                                 |                   |
| 18-29.9                              | 52 (35.6)          | 53 (37.6)      | 242 (32.6)                      | 347 (33.7)        |
| 30 - 34                              | 41 (28.1)          | 29 (20.6)      | 177 (23.9)                      | 247 (24.0)        |
| 35 - 39                              | 28 (19.2)          | 31 (22.0)      | 147 (19.8)                      | 206 (20.0)        |
| 40+                                  | 25 (17.1)          | 28 (19.9)      | 176 (23.7)                      | 229 (22.3)        |
| <b>Baseline CD4</b>                  |                    |                |                                 |                   |
| <350                                 | 96 (65.8)          | 73 (51.8)      | 296 (39.9)                      | 465 (45.2)        |
| 350 - 500                            | 26 (17.8)          | 22 (15.6)      | 91 (12.3)                       | 139 (13.5)        |
| ≥500                                 | 19 (13.0)          | 21 (14.9)      | 97 (13.1)                       | 137 (13.3)        |
| Missing                              | 5 (3.4)            | 25 (17.7)      | 258 (34.8)                      | 288 (28.0)        |
| <b>Education</b>                     |                    |                |                                 |                   |
| Less than grade 12                   | 97 (66.4)          | 95 (71.4)      | 544 (73.9)                      | 736 (72.5)        |
| Senior certificate/Matric or higher  | 49 (33.6)          | 38 (28.6)      | 192 (26.1)                      | 279 (27.5)        |
| <b>Marital Status</b>                |                    |                |                                 |                   |
| Single                               | 28 (19.2)          | 18 (12.8)      | 110 (14.8)                      | 156 (15.2)        |
| In a relationship                    | 92 (63.0)          | 98 (69.5)      | 497 (67.1)                      | 687 (66.8)        |
| Married                              | 21 (14.4)          | 18 (12.8)      | 112 (15.1)                      | 151 (14.7)        |
| Divorced/widowed                     | 5 (3.4)            | 7 (5.0)        | 22 (3.0)                        | 34 (3.3)          |
| <b>Employment Status</b>             |                    |                |                                 |                   |
| Unemployed                           | 70 (47.9)          | 66 (46.8)      | 402 (54.5)                      | 538 (52.5)        |
| Employed                             | 76 (52.1)          | 75 (53.2)      | 335 (45.5)                      | 486 (47.5)        |
| Part-time/shifts                     | 19 (25.0)          | 19 (27.5)      | 74 (17.2)                       | 112 (19.5)        |
| All day                              | 57 (75.0)          | 50 (72.5)      | 355 (82.8)                      | 462 (80.5)        |
| <b>Number of adults in household</b> |                    |                |                                 |                   |
| Lives alone                          | 28 (19.2)          | 21 (15.0)      | 160 (21.7)                      | 209 (20.5)        |
| Two adult in home                    | 82 (56.2)          | 81 (57.9)      | 429 (58.3)                      | 592 (57.9)        |
| ≥ three adults                       | 36 (24.7)          | 38 (27.1)      | 147 (20.0)                      | 221 (21.6)        |
| <b>Travel time to clinic</b>         |                    |                |                                 |                   |
| ≤15 minutes                          | 90 (61.6)          | 90 (63.8)      | 405 (54.6)                      | 585 (56.9)        |
| 16-30 minutes                        | 46 (31.5)          | 45 (31.9)      | 224 (30.2)                      | 315 (30.6)        |

>30 minutes 10 (6.8) 6 (4.3) 113 (15.2) 129 (12.5)

**Table 2: Demographic and clinical characteristics associated with initiating ART within 30 days of HIV diagnosis**

|                              | <b>Initiated ART within 30 days n(%)</b> | <b>Person years</b> | <b>Rates/100 PY (95% CI)</b> | <b>Crude HR (95% CI)</b> | <b>Adjusted HR (95% CI)</b> |
|------------------------------|------------------------------------------|---------------------|------------------------------|--------------------------|-----------------------------|
| <b>Guideline periods</b>     |                                          |                     |                              |                          |                             |
| Pre-UTT/ Cohort 1            | 54 (36.9)                                | 1.19                | 45.4 (34.8-59.3)             | 0.3 (0.2-0.3)            | 0.2 (0.2-0.3)               |
| UTT/ Cohort 2                | 93 (65.9)                                | 0.79                | 117.7 (96.1-144.3)           | 0.6 (0.5-0.7)            | 0.6 (0.5-0.7)               |
| Same day/ Cohort 3           | 593 (79.9)                               | 2.71                | 218.8 (201.7-236.9)          | 1.0                      | 1.0                         |
| <b>Sex</b>                   |                                          |                     |                              |                          |                             |
| Male                         | 266 (66.5)                               | 1.97                | 134.7 (119.4-151.9)          | 1.0                      | 1.0                         |
| Female                       | 474 (75.3)                               | 2.72                | 174.5 (159.5-190.9)          | 1.7 (1.4-2.0)            | 1.2 (1.0-1.4)               |
| <b>Age at testing</b>        |                                          |                     |                              |                          |                             |
| 18-29.9                      | 247 (71.1)                               | 1.57                | 157.3 (138.6-177.8)          | 1.0                      |                             |
| 30 - 34                      | 170 (68.8)                               | 1.10                | 154.5 (132.9-179.6)          | 1.0 (0.8-1.2)            |                             |
| 35 - 39                      | 146 (70.8)                               | 0.99                | 147.5 (125.2-173.1)          | 1.0 (0.8-1.2)            |                             |
| 40+                          | 177 (77.2)                               | 1.03                | 171.8 (148-199.9)            | 1.1 (0.9-1.3)            |                             |
| <b>Baseline CD4</b>          |                                          |                     |                              |                          |                             |
| <350                         | 146 (62.7)                               | 2.23                | 154.4 (138.9-171.6)          | 1.0                      | 1.0                         |
| 350 - 500                    | 238 (79.9)                               | 0.61                | 169.6 (139.8-205.7)          | 1.1 (0.9-1.4)            | 1.1 (0.9-1.4)               |
| ≥500                         | 172 (81.9)                               | 0.5                 | 217.9 (180.6-262.9)          | 1.3 (1.0-1.6)            | 1.2 (0.9-1.4)               |
| Missing                      | 194 (63.9)                               | 1.36                | 135.7 (117.5-156.8)          | 0.9 (0.8-1.1)            | 0.7 (0.6-0.8)               |
| <b>Education</b>             |                                          |                     |                              |                          |                             |
| < Grade 12                   | 527 (71.6)                               | 3.41                | 154.5 (142.1-168.5)          | 1.0                      |                             |
| ≥ Grade 12                   | 203 (72.7)                               | 1.23                | 165.0 (144.2-189.9)          | 1.1 (0.9-1.2)            |                             |
| <b>Marital Status</b>        |                                          |                     |                              |                          |                             |
| Single                       | 114 (73.0)                               | 0.71                | 160.6 (133.6-192.9)          | 1.00                     |                             |
| In a relationship            | 483 (70.3)                               | 3.09                | 156.3 (142.6-170.4)          | 1.0 (0.8-1.2)            |                             |
| Married                      | 119 (78.8)                               | 0.69                | 172.5 (142.7-204.3)          | 1.1 (0.8-1.4)            |                             |
| Divorced/widowed             | 23 (67.6)                                | 0.18                | 127.8 (83.1-188.3)           | 0.8 (0.5-1.3)            |                             |
| <b>Employment Status</b>     |                                          |                     |                              |                          |                             |
| Unemployed                   | 386 (71.7)                               | 2.47                | 156.3 (141.2-172.3)          | 1.0                      |                             |
| Employed                     | 351 (72.2)                               | 2.18                | 161.0 (144.6-178.2)          | 1.0 (0.9-1.2)            |                             |
| <b>Employment hours</b>      |                                          |                     |                              |                          |                             |
| Part-time/shifts             | 82 (73.2)                                | 0.49                | 167.3 (132.9-204.9)          | 1.0                      |                             |
| All day                      | 147 (31.8)                               | 2.13                | 2.13 (138.8-172.2)           | 1.0 (0.8-1.2)            |                             |
| <b># adults in household</b> |                                          |                     |                              |                          |                             |
| Lives alone                  | 141 (67.4)                               | 1.02                | 138.2 (117.1-162.9)          | 1.0                      | 1.0                         |
| Two adult in home            | 442 (74.6)                               | 2.6                 | 170.0 (154.8-186.5)          | 1.2 (1.0-1.4)            | 1.2 (1.0-1.4)               |

|                              |            |      |                     |               |               |
|------------------------------|------------|------|---------------------|---------------|---------------|
| ≥ three adults               | 153 (69.2) | 1.03 | 148.5 (126.8-174.1) | 1.1 (0.8-1.3) | 1.0 (0.8-1.3) |
| <b>Travel time to clinic</b> |            |      |                     |               |               |
| ≤15 minutes                  | 415 (70.9) | 2.73 | 152.0 (138.2-167.5) | 1.0           | 1.0           |
| 16-30 minutes                | 218 (69.2) | 1.52 | 143.4 (125.4-163.5) | 1.0 (0.8-1.1) | 0.9 (0.8-1.1) |
| >30 minutes                  | 107 (82.9) | 0.44 | 243.2 (200.9-293.5) | 1.5 (1.2-1.8) | 1.3 (1.1-1.7) |

**Table 3: Demographic and clinical characteristics associated with initiating ART on the day of HIV diagnosis**

|                          | <b>Initiated ART<br/>within same-day<br/>n(%)</b> | <b>Crude RR<br/>(95% CI)</b> | <b>Adjusted<br/>RR (95% CI)</b> |
|--------------------------|---------------------------------------------------|------------------------------|---------------------------------|
| <b>Sex</b>               |                                                   |                              |                                 |
| Male                     | 44 (15.6)                                         | 1.0                          | 1.0                             |
| Female                   | 106 (22.9)                                        | 1.5 (1.1-2.0)                | 1.3 (0.9-1.9)                   |
| <b>Age at testing</b>    |                                                   |                              |                                 |
| 18-29.9                  | 62 (25.6)                                         | 1.0                          | 1.0                             |
| 30 - 34                  | 38 (21.4)                                         | 0.8 (0.6-1.2)                | 0.9 (0.6-1.2)                   |
| 35 - 39                  | 24 (16.3)                                         | 0.6 (0.4-0.9)                | 0.7 (0.4-1.0)                   |
| 40+                      | 26 (14.7)                                         | 0.6 (0.4-0.9)                | 0.6 (0.4-0.9)                   |
| <b>Baseline CD4</b>      |                                                   |                              |                                 |
| <350                     | 44 (17.4)                                         | 1.0                          | 1.0                             |
| 350 - 500                | 18 (24.6)                                         | 1.3 (0.8-2.2)                | 1.3 (0.8-2.1)                   |
| ≥500                     | 20 (25.9)                                         | 1.4 (0.9-2.2)                | 1.2 (0.8-1.9)                   |
| Missing                  | 68 (35.7)                                         | 1.8 (1.3-2.5)                | 1.7 (1.3-2.4)                   |
| <b>Education</b>         |                                                   |                              |                                 |
| < Grade 12               | 107 (19.6)                                        | 1.0                          |                                 |
| ≥ Grade 12               | 43 (22.3)                                         | 1.1 (0.8-1.6)                |                                 |
| <b>Marital Status</b>    |                                                   |                              |                                 |
| Single                   | 17 (15.4)                                         | 1.0                          |                                 |
| In a relationship        | 117 (23.5)                                        | 1.5 (0.9-2.4)                |                                 |
| Married                  | 16 (14.2)                                         | 0.9 (0.5-1.7)                |                                 |
| Divorced/widowed         | -                                                 |                              |                                 |
| <b>Employment Status</b> |                                                   |                              |                                 |
| Unemployed               | 76 (18.9)                                         | 1.0                          |                                 |
| Employed                 | 72 (21.4)                                         | 1.1 (0.9-1.5)                |                                 |
| <b>Employment hours</b>  |                                                   |                              |                                 |
| Part-time/shifts         | 19 (25.6)                                         | 1.0                          |                                 |
| All day                  | 63 (17.7)                                         | 0.7 (0.4-1.1)                |                                 |

**# adults in household**

|                   |           |               |  |
|-------------------|-----------|---------------|--|
| Lives alone       | 30 (18.7) | 1.0           |  |
| Two adult in home | 88 (20.5) | 1.1 (0.8-1.6) |  |
| ≥ three adults    | 30 (20.4) | 1.1 (0.7-1.7) |  |

**Travel time to clinic**

|               |           |               |               |
|---------------|-----------|---------------|---------------|
| ≤15 minutes   | 77 (19.0) | 1.0           | 1.0           |
| 16-30 minutes | 41 (18.3) | 0.9 (0.7-1.4) | 0.9 (0.7-1.4) |
| >30 minutes   | 32 (28.3) | 1.5 (1.0-2.1) | 1.4 (1.0-2.0) |

**Table 4: Facility variability associated with ART initiation within 30 days or ART initiation within same-day.**

| Facility | Initiated ART within 30 days<br>n(%) | Crude HR<br>(95% CI) | Initiated ART within same-day<br>n(%) | Crude RR<br>(95% CI) |
|----------|--------------------------------------|----------------------|---------------------------------------|----------------------|
| PHC 1    | 145 (65.9)                           | 0.5 (0.4-0.7)        | 8 (10.0)                              | 0.3 (0.2-0.6)        |
| PHC 2    | 96 (48.4)                            | 0.3 (0.2-0.4)        | 9 (17.6)                              | 0.5 (0.3-1.0)        |
| PHC 3    | 169 (81.6)                           | 0.9 (0.7-1.1)        | 35 (16.9)                             | 0.5 (0.3-0.7)        |
| PHC 4    | 98 (78.4)                            | 1.00                 | 42 (33.6)                             | 1.0                  |
| PHC 5    | 121 (80.1)                           | 0.8 (0.6-0.9)        | 46 (30.4)                             | 0.9 (0.6-1.3)        |
| PHC 6    | 111 (86.7)                           | 0.9 (0.7-1.2)        | 10 (7.8)                              | 0.2 (0.1-0.4)        |

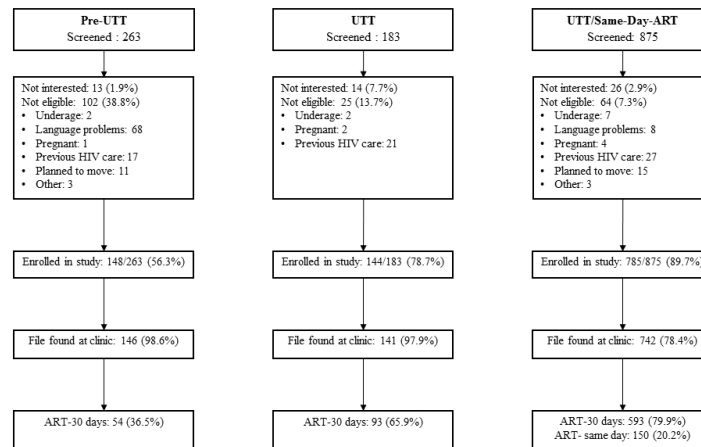


Figure 1. Participant flow in the three recruitment periods

338x190mm (96 x 96 DPI)

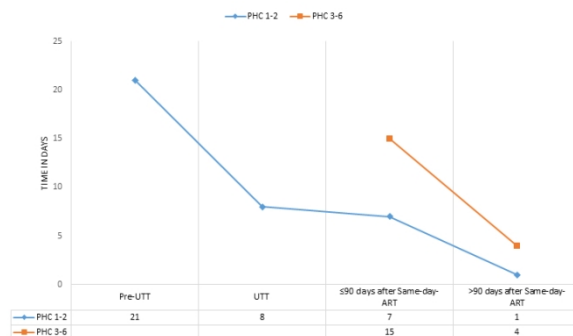


Figure 2. Timing of ART initiation in the first 30 days of HIV care across HIV treatment guideline periods in Johannesburg, South Africa

338x190mm (96 x 96 DPI)

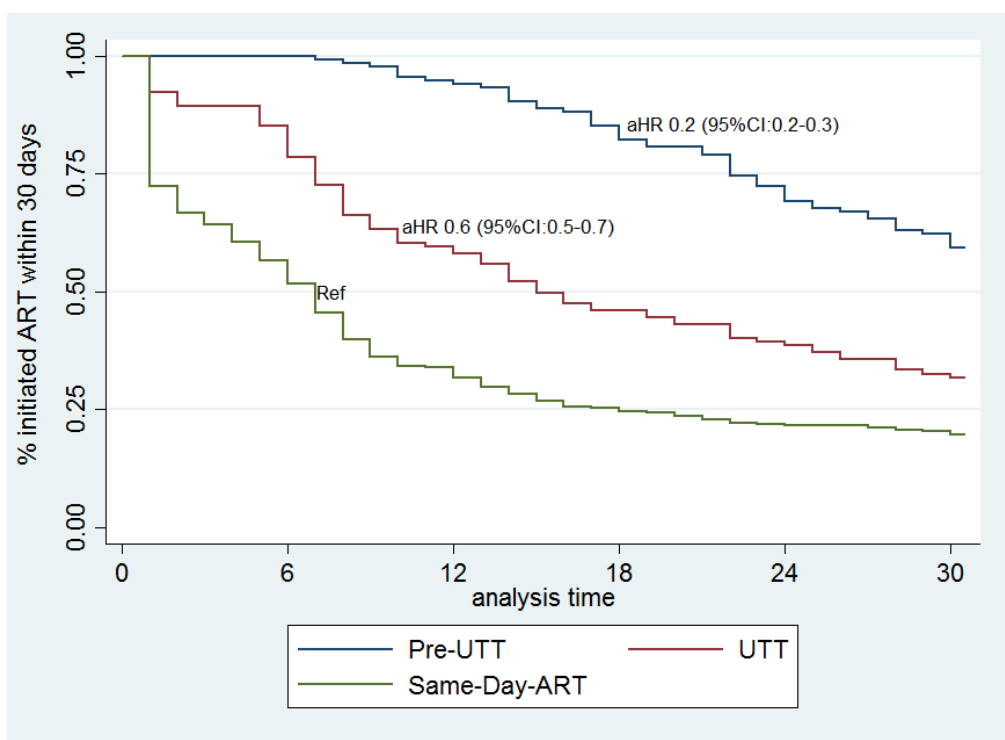


Figure 3. Hazards of starting ART within 30 days of HIV diagnosis by HIV treatment guideline periods in Johannesburg, South Africa  
304x221mm (72 x 72 DPI)

**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cohort studies**

| Section/Topic                | Item # | Recommendation                                                                                                                                                                       | Reported on page # |
|------------------------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| <b>Title and abstract</b>    | 1      | (a) Indicate the study's design with a commonly used term in the title or the abstract                                                                                               | 2-3                |
|                              |        | (b) Provide in the abstract an informative and balanced summary of what was done and what was found                                                                                  |                    |
| <b>Introduction</b>          |        |                                                                                                                                                                                      |                    |
| Background/rationale         | 2      | Explain the scientific background and rationale for the investigation being reported                                                                                                 | 4                  |
| Objectives                   | 3      | State specific objectives, including any prespecified hypotheses                                                                                                                     | 5                  |
| <b>Methods</b>               |        |                                                                                                                                                                                      |                    |
| Study design                 | 4      | Present key elements of study design early in the paper                                                                                                                              | 5                  |
| Setting                      | 5      | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection                                                      | 5                  |
| Participants                 | 6      | (a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up                                                           | 5                  |
|                              |        | (b) For matched studies, give matching criteria and number of exposed and unexposed                                                                                                  |                    |
| Variables                    | 7      | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable                                             | 5                  |
| Data sources/<br>measurement | 8*     | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 5                  |
| Bias                         | 9      | Describe any efforts to address potential sources of bias                                                                                                                            | 6                  |
| Study size                   | 10     | Explain how the study size was arrived at                                                                                                                                            |                    |
| Quantitative variables       | 11     | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why                                                         | 6                  |
| Statistical methods          | 12     | (a) Describe all statistical methods, including those used to control for confounding                                                                                                | 6                  |
|                              |        | (b) Describe any methods used to examine subgroups and interactions                                                                                                                  | 6                  |
|                              |        | (c) Explain how missing data were addressed                                                                                                                                          | 6                  |
|                              |        | (d) If applicable, explain how loss to follow-up was addressed                                                                                                                       |                    |
|                              |        | (e) Describe any sensitivity analyses                                                                                                                                                |                    |
| <b>Results</b>               |        |                                                                                                                                                                                      |                    |



|                          |     |                                                                                                                                                                                                                                                                                                                                                                                                               |                           |
|--------------------------|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| Participants             | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed<br>(b) Give reasons for non-participation at each stage<br>(c) Consider use of a flow diagram                                                                                                               | 6<br>Figure 1<br>Figure 1 |
| Descriptive data         | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders<br>(b) Indicate number of participants with missing data for each variable of interest<br>(c) Summarise follow-up time (eg, average and total amount)                                                                                                                | 6<br>Table 1<br>5-6       |
| Outcome data             | 15* | Report numbers of outcome events or summary measures over time                                                                                                                                                                                                                                                                                                                                                | 6-7                       |
| Main results             | 16  | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included<br>(b) Report category boundaries when continuous variables were categorized<br>(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | <br>6, Table 1            |
| Other analyses           | 17  | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses                                                                                                                                                                                                                                                                                                                | Tables 2-4                |
| <b>Discussion</b>        |     |                                                                                                                                                                                                                                                                                                                                                                                                               |                           |
| Key results              | 18  | Summarise key results with reference to study objectives                                                                                                                                                                                                                                                                                                                                                      | 7-8                       |
| <b>Limitations</b>       |     |                                                                                                                                                                                                                                                                                                                                                                                                               |                           |
| Interpretation           | 20  | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence                                                                                                                                                                                                                                    | 8                         |
| Generalisability         | 21  | Discuss the generalisability (external validity) of the study results                                                                                                                                                                                                                                                                                                                                         | 8-9                       |
| <b>Other information</b> |     |                                                                                                                                                                                                                                                                                                                                                                                                               |                           |
| Funding                  | 22  | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based                                                                                                                                                                                                                                                 | 10                        |

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Impact of the test and treat policy on delays in ART initiation among HIV positive adult patients from six clinics in Johannesburg, South Africa: results from a prospective cohort study

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Journal:                        | <i>BMJ Open</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Manuscript ID                   | bmjopen-2019-030228.R1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Article Type:                   | Original research                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Date Submitted by the Author:   | 26-Aug-2019                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Complete List of Authors:       | Onoya, Dorina; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office Sineke, Tembeka; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office Hendrickson, Cheryl; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office Mokhele, Idah; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office Maskew, Mhairi; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office Long, Lawrence; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office; Boston University, Boston School of Public Health, Department of Global Health Fox, Matthew; Boston University, Epidemiology and Global Health; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office |
| <b>Primary Subject Heading</b>: | Health policy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Secondary Subject Heading:      | HIV/AIDS, Public health, Health policy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Keywords:                       | HIV & AIDS < INFECTIOUS DISEASES, Public health < INFECTIOUS DISEASES, PRIMARY CARE, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

SCHOLARONE™  
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

1  
2  
3  
4 **+Working Title:**

5  
6 2 Impact of the test and treat policy on same-day ART delays in HIV treatment initiation in  
7  
8 3 Johannesburg, South Africa

9  
10 4 **Title: Impact of the test and treat policy on delays in ART initiation among HIV positive**  
11 **adult patients from six clinics in Johannesburg, South Africa: results from a prospective**  
12 **cohort study**

13  
14  
15  
16 7 **Authors:** Dorina Onoya<sup>1</sup>, Tembeka Sineke<sup>1</sup>, Cheryl Hendrickson<sup>1</sup>, Idah Mokhele<sup>1</sup>, Mhairi  
17  
18 8 Maskew<sup>1</sup>, Lawrence Long<sup>1,2</sup>, Matthew P. Fox<sup>1,2,3</sup>

19  
20 9 <sup>1</sup> Health Economics and Epidemiology Research Office, Department of Internal Medicine, School  
21  
22 10 of Clinical Medicine, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg,  
23  
24 11 South Africa

25 12 <sup>2</sup> Department of Global Health, Boston University School of Public Health, Boston, MA, USA

26  
27 13 <sup>3</sup> Department of Epidemiology, Boston University School of Public Health, Boston, MA, USA

28  
29  
30 15 **Corresponding author:** Dorina Onoya, Health Economics and Epidemiology Research Office,  
31  
32 16 39 Empire Road, Parktown, Johannesburg, 2193, South Africa, [donoya@heroza.org](mailto:donoya@heroza.org) +27 10 001  
33  
34 17 7930

35  
36 18  
37 19 **Keywords:** HIV, ART attrition, UTT, same-day ART

38  
39 20  
40 21 **Word count (main body):** 3169

42 22

43  
44  
45 23

46  
47 24

48  
49 25

50  
51 26

52  
53  
54 27

## 1 Abstract

2 **Objectives** To assess delays to antiretroviral therapy (ART) initiation before the Universal Test  
3 & Treat (UTT) policy, under UTT and during same-day ART policy periods in Johannesburg,  
4 South Africa.

5 **Design** Prospective cohort study

6 **Setting** Patients were recruited from six primary health clinic in Johannesburg.

7 **Participants** Overall, 1029 newly diagnosed HIV positive adults ( $\geq 18$  years) were consecutively  
8 enrolled by referral from the testing HIV counsellor between April to December 2015 (Pre-UTT  
9  $n=146$ ), July-August 2017 (UTT,  $n=141$ ) and October 2017-August 2018 (same-day ART,  
10  $n=742$ ).

11 **Main outcome measures** Predictors of 30-days ART initiation uptake were assessed using Cox  
12 proportional hazards models. Additionally, predictors of same-day ART initiation were evaluated  
13 using Poisson regression modelling.

14 **Results** Overall, 30-days ART proportions were 71.9% overall, 36.9% pre-UTT, 65.9% under  
15 UTT and 79.9% under the same-day ART policy. The median days to ART initiation declined  
16 from 21 pre-UTT (IQR: 15-30) to eight (IQR: 6-16) under UTT and five days (IQR: 0-8) under  
17 the same-day ART policy. However, only 150 (20.2%) of the same-day ART cohort initiated  
18 ART immediately after HIV diagnosis. Living in a two-adult home (adjusted Hazard ratio (aHR)  
19 1.2 vs living alone, 95% Confidence Interval (CI): 1.0-1.4) increased the likelihood of 30-day  
20 ART. Missing baseline CD4 data decreased the likelihood of 30-days ART by 40% (aHR 0.6 vs  
21  $CD4 < 350$  cell/ $\mu$ l, 95% CI: 0.5-0.7). Women were more likely to take up immediate ART (aRR  
22 1.3, 95%CI: 1.0-1.9). Participants  $\geq 40$  years (aRR 0.6 vs 18-24 years old, 95% CI: 0.4-0.9) were  
23 less likely to start ART on the day of HIV diagnosis. However, same-day ART rates increased  
24 with longer policy implementation time (aRR 0.2 for  $< 3$ -months vs  $> 10$ -months, 95%CI: 0.1-  
25 0.4).

26 **Conclusions** Our results highlight a positive move towards earlier ART initiation during the  
27 UTT and same-day ART periods and emphasise a need to increase same-day ART  
28 implementation further.

1  
2  
3 1 **Word count: 300**  
4  
5  
6 2  
7

8 3 **Strengths and limitations**  
9

- 10 4 • Cohorts enrolled across the three most recent ART guideline implementation periods in  
11 South Africa, allowing observation of changes over time.  
12 5  
13  
14 6 • Participants enrolled immediately after HIV diagnosis, allowing for observation of ART  
15 initiation and patient attrition from HIV diagnosis.  
16 7  
17  
18 8 • Our results highlight a positive move towards earlier initiation of HIV treatment after the  
19 UTT policy implementation.  
20 9  
21  
22 10 • Although we demonstrate substantial reductions in delays to ART initiation (median of 21 to  
23 five days), ART initiation on the day of HIV diagnosis is limited and requires additional  
24 investigations to improve programmatic performance.  
25 12  
26  
27 13 • Increases in missing baseline laboratory tests at diagnosis reduce the strength of laboratory  
28 datasets as monitoring tools for the early steps of the HIV treatment cascade and delay the  
29 assessment of the appropriateness of the initial ART regimen.  
30 15  
31  
32 16  
33  
34 17  
35  
36 18  
37  
38 19  
39  
40 20  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## 1 Introduction

2 South Africa has the largest Human Immunodeficiency Virus (HIV) epidemic in the world, with  
3 an estimated 7.9 million persons living with HIV (1). To increase access to antiretroviral therapy  
4 (ART), the South African government gradually increased the cluster of differentiation four  
5 (CD4)-based treatment eligibility threshold from 200 cells/ $\mu$ l in 2004, to 350 cells/ $\mu$ l in 2010 and  
6 500 cells/ $\mu$ l in January 2015 (2-6).

7 In 2017, an estimated 4.4 million (55.7%) HIV-positive patients had been initiated on ART (1),  
8 highlighting the high patient attrition between HIV diagnosis and ART initiation. Determinants  
9 of losses in the HIV treatment cascade include cluster of differentiation four (CD4) cell count at  
10 diagnosis, gender, socio-economic factors such as disclosure and HIV stigma, access to health  
11 care facilities, travel time and cost of attending clinic visits (7-14). In the past, attrition from  
12 care after HIV diagnosis was also related to the number of assessment and counselling visits  
13 required before treatment initiation for eligible patients and the lack of systematic monitoring of  
14 and benefits for patients who were not offered ART (2-6, 14).

15 In September 2016, South Africa removed the CD4 cell count threshold for ART eligibility and  
16 adopted the World Health Organization (WHO) 2015 Universal Test and Treat (UTT) policy  
17 making all HIV positive patients eligible for ART at diagnosis (15-17). South Africa's adoption  
18 of the UTT policy was based on the availability of safer, more tolerable drug combinations and  
19 reliable evidence of the positive impact of early ART initiation on morbidity and viral  
20 suppression outcomes (18-20). Clinical trials showed that, compared to patients who deferred  
21 ART, patients who started treatment immediately after HIV diagnosis had lower rates of  
22 acquired immunodeficiency syndrome (AIDS)-related adverse events and improved viral  
23 suppression rates with no difference in post-initiation attrition rates (21-22). Additionally,  
24 various studies showed that, compared to patients who deferred ART, patients who started ART  
25 immediately after diagnosis were less likely to transmit HIV to HIV-negative partners (16, 21-  
26 23).

27 In September 2017, the UTT policy in South Africa was updated with a directive to initiate ART  
28 on the day of HIV diagnosis (same-day ART) (24). While widespread support for the UTT or  
29 "treat all" policy has created momentum for its promulgation, there remain reservations from  
30 primary health care (PHC) providers that health system capacity constraints may limit same-day

1 ART policy assimilation and result in variations in implementation at facility-level (25). The  
2 policy was implemented amid concerns that, under UTT, health facilities in high burden settings,  
3 in particular, might struggle with the increased patient burden, potentially reducing the quality of  
4 care provided to new and existing patients (2-4,26-27). There are also concerns around patient  
5 acceptance of same-day ART, ART refusal or early patient disengagement from care or  
6 intermittent adherence after starting ART (28).

7 The 2017 National HIV survey in South Africa reported increases in the number of HIV positive  
8 patients initiated on ART (nearly one million additional patients have been started on ART  
9 between 2016 and 2017 (1). However, in addition to measuring program success in terms of  
10 expanded access to ART, critical outcomes of the UTT policy include the initiation of patients  
11 with high CD4 cell count, reductions in delays to ART initiation and long-term retention in HIV  
12 care.

13 In this study, we set out to measure ART initiation of newly diagnosed adults in the first 30 days  
14 of HIV care (30-day ART), across the three recent ART guideline periods and to examine factors  
15 associated with 30-days ART in Johannesburg, South Africa.

## 17 **Methods**

### 18 *Study Setting and design*

19 This study was conducted at six of 15 peri-urban, public-sector PHCs in the Johannesburg health  
20 sub-district A, South Africa. PHC clinics in Johannesburg are mainly nurse-run with the support  
21 of one medical doctor and are responsible for HIV testing, ART initiation and primary-level  
22 management and monitoring of HIV positive patients. We conducted a prospective cohort study,  
23 enrolling consenting newly diagnosed HIV positive adult ( $\geq 18$  years) patients from April to  
24 December 2015 (Pre-UTT period), July-August 2017 (UTT period) and October 2017-August  
25 2018 (same-day ART period). Pre-UTT and UTT cohorts were only enrolled from two PHCs in  
26 Johannesburg while the same-day ART cohort included four additional PHCs in the same area  
27 (serving similar populations) in Johannesburg (Summarised in Table 1) (10-13). The sample size  
28 for the same-day ART cohort was increased to enable a separate assessment of ART refusal and



1 attrition among participants who initiate ART with high CD4 count (>500 cells/ $\mu$ l). The number  
2 of sites was increased to six to allow comparison of the same-day ART across clinics.

3 Participant enrolment co-occurred across sites until the total planned sample size was attained.  
4 Figure one outlines the criteria for being excluded from the study. All patients were enrolled in  
5 the study after an HIV-positive diagnosis (before ART eligibility determination) by trained study  
6 interviewers via referral from PHC-based lay HIV counsellors. Patients were eligible if they had  
7 entered HIV care after an HIV-positive diagnosis. Entering HIV care was defined as providing  
8 the first blood sample for baseline safety laboratory tests for the Pre-UTT and UTT cohorts, and  
9 defined as having received the HIV positive test result for the same-day ART cohort because  
10 new clinic processes meant that patients were likely to start ART before the first blood  
11 collection. Women who were pregnant at HIV diagnosis were excluded from the study because  
12 their antenatal care ART initiation and monitoring processes differ from that of non-pregnant  
13 populations. Study staff cooperated closely with lay HIV counsellors across sites and checked  
14 HIV testing records daily to ensure that the maximum number of testers were being referred to  
15 study staff for study eligibility assessment.

### 16 *Data Collection*

17 Consenting patients completed an interviewer-administered baseline questionnaire after HIV  
18 testing, on the day of HIV diagnosis. The interview was conducted exclusively in English in the  
19 pre-UTT cohort but later translated to Sotho and Zulu as well for the UTT and same-day ART  
20 cohorts. The interview included questions on demographic factors, socioeconomic status and  
21 health-seeking behaviour. The recency of the HIV diagnosis was determined from patient  
22 responses in the baseline questionnaire. Patients were passively followed up by medical record  
23 review up to 30 days after the HIV diagnosis to determine ART initiation. Person-time accrued  
24 from the date of HIV diagnosis (study enrolment) until ART initiation. We assumed that all  
25 patients for whom clinic files were created were in care for the first 30 days unless there was  
26 evidence of an official transfer or death in the first 30 days after HIV diagnosis. Trained data  
27 collectors captured routine clinical follow-up data of consenting participants from facility-based  
28 paper and electronic medical records including laboratory test results from the National Health  
29 Laboratory Services (NHLS). We define baseline CD4 as the CD4 results from tests conducted  
30 on the first blood specimen drawn after HIV diagnosis. Trained data collectors captured all

1 patient data on the REDCap (Research Electronic Data Capture) systems (Vanderbilt University,  
2 Nashville, Tennessee). All datasets were exported to STATA 14 (StataCorp, College Station,  
3 Texas) for the analysis.

#### 4 *Patient and Public Involvement*

5 Patients were not directly involved in the design of this study or reimbursed for their  
6 participation in the study. However, information collected from patients in previous studies  
7 informed the design, data collection approaches and interpretation of study results (19, 24). Also,  
8 the study implementation was guided by health care workers from participating study sites.  
9 Study participants consented to a once-off direct data collection after HIV diagnosis and passive  
10 follow-up data collection via medical record review. Therefore, direct result dissemination to  
11 patients will not be possible. However, we plan to present study results to health care workers  
12 and policy-makers at participating PHC clinics and at other policy-relevant forums.

#### 13 *Outcome data and analysis*

14 The primary exposure variable was the ART guidelines at the time of HIV diagnosis categorised  
15 as pre-UTT (active between January 2015 and August 2016), under the general UTT (active  
16 between September 2016 and August 2017) policy and the same-day ART policy (active from  
17 September 2017). The primary outcome was ART initiation up to 30 days after HIV diagnosis  
18 (30-day ART), and the secondary outcome is ART initiation immediately after HIV diagnosis,  
19 both outcomes were coded Yes (1) or No (0). Final data analysis began in October 2018.

20 Continuous variables were described using medians and interquartile ranges. Categorical  
21 variables were described using percentages. Kaplan Meier analyses were conducted to assess  
22 time to ART initiation in the first 30 days of HIV care. Predictors of 30-day ART were modelled  
23 using Cox proportional hazards regression, reporting Hazard Ratios (HR). Variables with a p-  
24 value <0.1 in crude analyses were entered in the multivariate model. Schoenfeld residuals were  
25 used to test the assumption of proportional hazards. Interaction terms with time-varying  
26 covariates were created for variables that violated the proportional hazards assumption. Variables  
27 were excluded from the model when the inclusion of the interaction term did not resolve the  
28 proportional hazards assumption violation. Missing data were accounted for by including a 'not  
29 measured/missing' category where necessary. Additionally, predictors of ART initiation on the

1 day of HIV diagnosis (dichotomised) were evaluated using Poisson Regression modelling, reporting Relative Risks (RR).

3 All multivariate analyses were adjusted for the time from the period-specific policy announcement to account for the varying lag periods between policy implementation and participant enrolment across cohorts. Additionally, we tested the association between the highest level of education and ART initiation across guidelines period to account for the change in interview language options. The study protocol was reviewed and approved by the Institutional Review Boards of the University of Witwatersrand (M141103) in South Africa and Boston University (H-33516) in the USA.

## 11 Results

### 12 *Clinical and demographic characteristics at baseline*

13 Although 1077 (100% of target sample) HIV positive adults enrolled in the study, medical data was available for 1029 (95.5%), 146 (98.6%) pre-UTT, 141 (97.9%) under UTT, and 742 (78.4%) under the same-day ART policy (Figure 1). The exclusive use of English questionnaires in the pre-UTT cohort was the largest reason for participant non-eligibility (25.9% of total screened). However, the age and gender distributions were similar across cohorts (Median 32.6 years for Pre-UTT, interquartile range (IQR):27.2-37.6; 32.3 years for UTT, IQR: 27.2-38.9; and 32.3 years for same-day ART, IQR: 28.4-39.5) (Table 2). Women (Median 32.6 years, IQR: 27.0-37.7) were slightly younger at HIV diagnosis than men (Median 35.8, IQR: 32.1-41.5) ( $\beta_{\text{female}} -3.4$ , 95%CI: -4.4 to -2.4). The pre-UTT cohort had a marginally higher proportion of participants who completed grade 12 (33.6%) compared to 28.6% in the UTT and 26.1% in the same-day ART cohorts. Employment rates were also similar across cohorts (47.9% pre-UTT, 46.8% UTT and 54.5% same-day ART).

25 Although the proportion of participants who tested with CD4 count<350/mm<sup>3</sup> decreased from 65.8% pre-UTT to 39.7% in the same-day ART cohort, the percentage of patients with missing baseline CD4 count results increased from 3.4% to 34.7%, respectively. Among participant who had CD4 data, the proportion of patient with baseline CD4 count>500 cells/ $\mu$ l did not change substantially across guideline periods (20.0% during same-day ART vs 13.5% Pre-UTT, relative

1 risk (RR)=1.5 (95%CI: 0.9-2.3) and RR=1.3 (95%CI: 0.9-2.4) for same-day ART vs UTT  
2 (18.1%).

3 Although most participants lived within 15 minutes of the diagnosing clinic (56.9%), a small  
4 proportion reported travelling over 30 minutes to the clinic (12.5% overall, 6.8% pre-UTT, 4.3%  
5 under UTT and 15.2% under the same-day ART policies). Travel time varied across clinics such  
6 that <12% participants from five of the six recruitment sites reported travelling over 30 minutes  
7 to the clinics, but 46.4% of participants from PHC four reported >30-minutes travel time.

### 8 *Time to ART initiation from HIV diagnosis across guideline periods*

9 The overall median days to ART initiation declined from 21 days (IQR: 15-30) to eight days  
10 (IQR: 6-16) after the implementation of the UTT policy. Time to ART start was further reduced  
11 to a median of five days (IQR: 0-8) after the same-day ART directive was given (Figure 2), with  
12 most reductions observed three months after the same-day ART policy directive was given to  
13 PHCs. Overall, 71.9% initiated ART within 30 days of HIV diagnosis, 36.9% pre-UTT (44.3%  
14 of those eligible for ART), 65.9% under UTT and 79.9% under the same-day ART periods  
15 (Figure 3).

16 Overall, 30-day ART rates increased with increasing lag time from the prevailing (at the time of  
17 participant's HIV diagnosis) policy announcement (adjusted hazard ratio (aHR) 0.4 for  $\leq 3$ -  
18 months vs  $\geq 10$ -months, 95%CI: 0.2-0.6). The highest level of education was not associated with  
19 30-day ART uptake. After adjusting for the facility of diagnosis and lag time from the policy  
20 announcement, pre-UTT participants were 80% less likely to initiate ART in the first 30 days  
21 (aHR 0.2, 95% CI: 0.2-0.4) compared to same-day ART participants (Table 3). Similarly,  
22 patients diagnosed under the UTT policy were 70% less likely to start ART within 30 days of  
23 HIV diagnosis (aHR 0.3, 95% CI: 0.2-0.5) compared to same-day ART participants (Figure 3).

24

1 While women had higher 30-day ART rates compared to men (aHR 1.2, 95%CI: 1.0-1.4), there  
2 was no meaningful difference in the likelihood of 30-days ART initiation across age, marital  
3 status, travel time to the clinic or employment categories. Overall, compared to patients with  
4 baseline CD4<350 cell/ $\mu$ l, participants with baseline CD4>500 cells/ $\mu$ l had similar rates of 30-  
5 day ART. However, participants who were missing baseline CD4 counts were 40% less likely to  
6 start ART within a month (aHR 0.6, 95% CI: 0.5-0.7). Participants who lived in a two-adult  
7 home had higher rates of 30-day ART than those who lived alone (aHR 1.2, 95%CI: 1.0-1.5).  
8 Women were more likely to live with at least one other adult (RR 1.2, 95%CI: 1.1-1.4) compared  
9 to men.

#### 10 *Demographic and clinical characteristics associated with immediate ART initiation within the* 11 *same-day ART cohort*

12 Within the same-day ART cohort, 150 (20.2%) participants initiated treatment on the day of HIV  
13 diagnosis (25.3% of those who initiated ART within 30 days). Women were more likely to take  
14 up immediate ART (aRR 1.3, 95%CI: 1.0-1.9). Older participants (aRR 0.6 for patients  $\geq$ 40  
15 years old compared to patients in the 18-24 years group, 95% CI: 0.4-0.9) were less likely to start  
16 ART on the day of HIV diagnosis (Table 4). In the same-day ART period, missing baseline CD4  
17 data did not affect the likelihood of starting ART on the day of HIV diagnosis (aRR 1.5, 95%CI:  
18 0.5-3.7). We also describe a high variability in same-day ART policy implementation across sites  
19 (Table 4). However, same-day ART rates increased gradually with longer policy implementation  
20 time (aRR 0.2 for <3 months vs >10 months, 95%CI: 0.1-0.4) (Figure 4).

## 22 **Discussion**

23 This study highlights a marked reduction in time to ART initiation following the implementation  
24 of the UTT guidelines, decreasing from a median of 21 days to eight days, despite this policy not  
25 including a directive to modify ART initiation times. An additional decline in time to ART start  
26 was also observed after the same-day ART memorandum was sent to clinics. These declines are  
27 consistent with the goals of the WHO HIV treatment guidelines: to initiate patients as early as  
28 possible to achieve better clinical outcomes (15-16).

1 Consistent with previous findings (29), we found a decrease in the proportion of patients  
2 presenting with CD4 <350 cells/ $\mu$ l but little improvement in the CD4>500 cells/ $\mu$ l group  
3 between the pre-UTT and same-day ART periods. Overall, nearly two-thirds of participants who  
4 had baseline CD4 data were diagnosed with HIV with low CD4 counts (<350 cell/ $\mu$ l). Over one-  
5 third of the same-day ART cohort was missing baseline CD4 data.

6 Missing baseline CD4 data in the same-day ART cohort could have resulted from the lack of  
7 clarity in the policy with regards to the need or timing of safety blood tests early in the same-day  
8 ART policy implementation or patient impatience with the drawn-out HIV testing and ART  
9 initiation processes on the day of HIV testing (17, 25, 30). It is unclear whether this is a result of  
10 the change in the definition of entry in HIV care (first blood draw vs HIV diagnosis) for the  
11 same-day ART cohort. However, this increase in missing baseline CD4 could also be observed  
12 from the pre-UTT cohort to the UTT cohort, at which point clinics already began to reduce time  
13 to ART start (to the first week of care for some patients). Nevertheless, having a missing baseline  
14 CD4 was associated with a reduced likelihood of 30-day ART compared to patients with lower  
15 baseline CD4 values. When we restricted the analysis to the same-day ART cohort, having a  
16 missing CD4 count was associated with a non-significant increase in same-day ART rates, which  
17 possibly also means that patients diagnosed under the same-day ART policy may start ART  
18 before the first blood draw a defer baseline CD4 tests. However, this finding must be explored  
19 further.

20 Interestingly, participants who lived in a two-adult home rather than alone were more likely to  
21 initiate ART within 30 days. However, participants who lived in larger households had similar  
22 30-day ART rates to those who lived alone, suggesting persisting fear of confidentiality breaches  
23 within homes (5, 8).

24 Only 20.2% of diagnosed patients under the same-day ART policy started ART on the day of  
25 diagnosis, highlighting possible facility-level policy assimilation challenges. In a previous  
26 qualitative study involving PHC health providers, we found marked variability in the buy-in of  
27 health care workers and the application of the same-day ART policy across health facilities (25).  
28 Healthcare providers expressed reservations about the acceptability of immediate ART for the  
29 majority of their patients and the feasibility of the strategy considering their current workload  
30 (25). However, same-day ART rates steadily increased over time, suggesting improvements

1 policy assimilation. Rates of ART initiation on the day of HIV diagnosis and up to 30 days after  
2 HIV diagnosis were higher among women than men. Women were, on average, younger at HIV  
3 diagnosis than men, highlighting the persisting need for consistent efforts to increase early HIV  
4 testing and ART initiation of high-CD4 and younger men.

5 The strength of these analyses lies in the three prospective cohorts, spanning three ART  
6 guideline periods in South Africa, allowing direct observation of the changes in ART uptake  
7 over time. However, the study data are limited by the small number of health facilities assessed  
8 as well as limited information about additional facility-level interventions and the contributions  
9 by partner organisations in supporting policy assimilation and implementation. Therefore, other  
10 data from a more representative facility survey are needed to better explain the facility-level  
11 variations in ART policy implementation and outcomes. Additionally, we only collected ART  
12 initiation data from testing facilities with a short follow-up period and were not able to determine  
13 if some participants went on to start ART elsewhere. Furthermore, the reason for the higher ART  
14 uptake among same-day ART participants require further exploration around the ART initiation  
15 processes and their potential impact on patients' future health-seeking behaviour as well as long  
16 term on-ART outcomes.

## 18 **Conclusion**

19 Our results highlight a positive move towards earlier ART initiation after the implementation of  
20 the UTT and same-day ART policies. However, the results also emphasise a vital need to  
21 streamline processes to increase same-day ART implementation/uptake further but also ensure  
22 timeous baseline safety and monitoring blood tests. Going forward, the need to improve patient  
23 demand for early HIV testing remains pertinent to achieve the prevention and treatment benefits  
24 of ART.

## 26 **Acknowledgements**

27 We extend our gratitude to the staff of PHC clinics who supported the implementation of the  
28 study and our sincere thanks go to the patients attending these clinics for their willingness to  
29 participate and share the valuable information that made this study possible.

## 1 **Author Contributions**

2 DO and MPF had the original idea for the study and paper. TS managed the study  
3 implementation and conducted the primary data analysis. TS, CH, IM, implemented the study  
4 and contributed to the result interpretation. LL and MM contributed to the interpretation of the  
5 results. All authors reviewed and approved the manuscript.

## 7 **Conflict of Interest**

8 Authors have no conflicts of interest to declare.

## 10 **Funding**

11 This study has been made possible by the generous support of the American People and the  
12 President's Emergency Plan for AIDS Relief (PEPFAR) through United States Agency for  
13 International Development (USAID) under the terms of Cooperative Agreements AID-674-A-  
14 12-00029 and 72067419CA00004 to HE2RO. The contents are the responsibility of the authors  
15 and do not necessarily reflect the views of PEPFAR, USAID or the United States Government.

## 17 **Data Statement**

18 Patient medical records are owned by the study site and the National Department of Health  
19 (South Africa) and governed by the Human Research Ethics Committee (University of  
20 Witwatersrand, Johannesburg, South Africa). All relevant data is included in the paper.

## 22 **References**

- 24 1. HSRC. The Fifth South African National HIV Prevalence, Incidence, Behaviour and  
25 Communication Survey, 2017: HIV Impact Assessment Summary Report. Cape Town,  
26 HSRC Press.; 2017.



- 1  
2  
3 1 2. Boyer S, Iwuji C, Gosset A, Protopopescu C, Okesola N, Plazy M, et al. Factors  
4 2 associated with antiretroviral treatment initiation amongst HIV-positive individuals linked  
5 3 to care within a universal test and treat programme: early findings of the ANRS 12249  
6 4 TasP trial in rural South Africa. *AIDS Care*. 2016;28(sup3):39-51.  
7 5  
8 5  
9
- 10 6 3. Collins S, Geffen N. Community views: balancing the public health benefits of earlier  
11 7 antiretroviral treatment with the implications for individual patients – perspectives from  
12 8 the community. *Current Opinion in HIV and AIDS*. 2014;9(1):4-10.  
13 9  
14
- 15 10 4. Cassim N, Coetzee LM, Schnippel K, Glencross DK. Estimating Implementation and  
16 11 Operational Costs of an Integrated Tiered CD4 Service including Laboratory and Point of  
17 12 Care Testing in a Remote Health District in South Africa. *PLoS ONE*.  
18 13 2014;9(12):e115420.  
19 14  
20 14
- 21 15 5. Human Sciences Research Council (HSRC). *The People Living With HIV Stigma Index: South Africa 2014*. HSRC Press: 2014 Accessed October 2018  
22 16  
23 17 <http://www.stigmaindex.org/sites/default/files/reports/Summary-Booklet-on-Stigma-Index-Survey%20South%20Africa.pdf>  
24 18  
25 19  
26 19  
27
- 28 20 6. [Goudge J, Ngoma B, Manderson L, Schneider H. Stigma, identity and resistance among people living with HIV in South Africa. SAHARA-J: Journal of Social Aspects of HIV/AIDS. 2009;6\(3\):94-104.](#)  
29 21  
30 22  
31 23  
32 23
- 33 24 7. [Abrahams N, Jewkes R. Managing and resisting stigma: a qualitative study among people living with HIV in South Africa. Journal of the International AIDS Society. 2012 Apr;15\(2\):10-7448.](#)  
34 25  
35 26  
36 26  
37 27  
38
- 39 28 8. Treves-Kagan S, Steward WT, Ntswane L, Haller R, Gilvydis JM, Gulati H, Barnhart S, Lippman SA. Why increasing availability of ART is not enough: a rapid, community-based study on how HIV-related stigma impacts engagement to care in rural South Africa. *BMC public health*. 2015 Dec;16(1):87.  
40 29  
41 30  
42 31  
43 32  
44 32
- 45 33 9. South African National Department of Health (SA-NDoH). *National Antiretroviral Treatment Guidelines, 2004*. Pretoria: SA-NDoH;2004.  
46 34  
47 35  
48 36
- 49 37 10. South African National Department of Health (SA-NDoH). *National Antiretroviral Treatment Guidelines, 2010*. Pretoria: SA-NDoH;2010.  
50 38  
51 38
- 52 39 11. South African National Department of Health (SA-NDoH). *Circular on new criteria for initiating adults on ART at CD4 count of 350 cells/ml and below 2011*. Pretoria: SA-NDoH; 2011.  
53 40  
54 41  
55 42  
56 42

12. South African National Department of Health (SA-NDoH). National Antiretroviral Treatment Guidelines 2013. Pretoria: SA NDoH;2013.
13. South African National Department of Health (SA-NDoH). National Consolidated Guidelines for the prevention of mother-to-child transmission of HIV (PMTCT) and the management of HIV in children, adolescents and adults 2015: SA NDoH;2015.
14. Ahmed S, Autrey J, Katz IT, Fox MP, Rosen S, Onoya D, et al. Why do people living with HIV not initiate treatment? A systematic review of qualitative evidence from low- and middle-income countries. *Social Science & Medicine*. 2018;213:72-84.
15. Abuelezam N N, McCormick AW, Fussell T, Afriyie AN, Wood R, DeGruttola V, et al. Can the Heterosexual HIV Epidemic be Eliminated in South Africa Using Combination Prevention? A Modeling Analysis. *American journal of epidemiology*. 2016;184(3):239-48.
16. Eaton JW, Johnson LF, Salomon JA, Bärnighausen T, Bendavid E, Bershteyn A, et al. HIV Treatment as Prevention: Systematic Comparison of Mathematical Models of the Potential Impact of Antiretroviral Therapy on HIV Incidence in South Africa. *PLOS Medicine*. 2012;9(7):e1001245.
17. South African National Department of Health (South Africa). Implementation of Universal Test and Treat Strategy for HIV positive patients and differentiated care for stable patients 2016. Pretoria: National Department of Health, 2016.  
<https://sahivsoc.org/Files/22%208%2016%20Circular%20UTT%20%20%20Decongestion%20CCMT%20Directorate.pdf>  
Accessed October 2018
18. Group TAS, Danel C, Moh R, Gabillard D, Badje A, Le Carrou J, et al. A Trial of Early Antiretrovirals and Isoniazid Preventive Therapy in Africa. *The New England journal of medicine*. 2015;373(9):808-22.
19. Lundgren JD, Babiker AG, Gordin F, Emery S, Grund B, Sharma S, et al. Initiation of Antiretroviral Therapy in Early Asymptomatic HIV Infection. *N Engl J Med*. 2015;373(9):795-807.
20. Rosen S, Maskew M, Fox MP, Nyoni C, Mongwenyana C, Maletle G. Initiating Antiretroviral Therapy for HIV at a Patient's First Clinic Visit: The RapIT Randomized Controlled Trial. 2016;13(5):e1002015.
21. INSIGHT START Study Group, Lundgren JD, Babiker AG, et al. Initiation of Antiretroviral Therapy in Early Asymptomatic HIV Infection. *New England Journal of Medicine*. 2015;373(9):795-807.

- 1  
2  
3 1 22. Cohen MS, Chen YQ, McCauley M, Gamble T, Hosseinipour MC, Kumarasamy N,  
4 2 Hakim JG, Kumwenda J, Grinsztejn B, Pilotto JH, Godbole SV. Prevention of HIV-1  
5 3 infection with early antiretroviral therapy. *New England journal of medicine*. 2011 Aug  
6 4 11;365(6):493-505.  
7 5  
8 6  
9 7 23. Tanser F, Bärnighausen T, Grapsa E, Zaidi J, Newell ML. High coverage of ART  
10 8 associated with decline in risk of HIV acquisition in rural KwaZulu-Natal, South Africa.  
11 9 *Science*. 2013 Feb 22;339(6122):966-71..  
12 10  
13 11 24. South African National Department of Health (South Africa). Tracking implementation of  
14 12 the 90-90-90 strategy for HIV, through the implementation of Test and Treat (TT) policy  
15 13 and same-day anti-retroviral therapy (ART) initiation for HIV positive patients 2017.  
16 14 Pretoria: National Department of Health; 2017.  
17 15  
18 16 25. Onoya D, Mokhele I, Sineke T, Ngoma B, Moolla A, Vujovic M, Bor J, Langa J, Fox M  
19 17 P. Health provider perspectives on implementation of same-day ART initiation six months  
20 18 after policy change in South Africa. *International AIDS Conference (poster)*; 2018;  
21 19 Amsterdam.  
22 20  
23 21 26. Kulkarni SP, Shah KR, Sarma KV, Mahajan AP. Clinical Uncertainties, Health Service  
24 22 Challenges, and Ethical Complexities of HIV “Test-and-Treat”: A Systematic Review.  
25 23 *American Journal of Public Health*. 2013;103(6):e14-e23.  
26 24  
27 25 27. Skhosana M, Reddy S, Reddy T, Ntoyanto S, Spooner E, Ramjee G, et al. PIMA TM  
28 26 point-of-care testing for CD4 counts in predicting antiretroviral initiation in HIV-infected  
29 27 individuals in KwaZulu-Natal, Durban, South Africa. *Southern African Journal of HIV  
30 28 Medicine*.2016;17(1).  
31 29  
32 30 28. Bigna JJR, Plottel CS, Koulla-Shiro S. Challenges in initiating antiretroviral therapy for  
33 31 all HIV-infected people regardless of CD4 cell count. *Infectious Diseases of Poverty*.  
34 32 2016;5(1):85.  
35 33  
36 34 29. Siedner MJ, Ng CK, Bassett IV, Katz IT, Bangsberg DR, Tsai AC. Trends in CD4 count  
37 35 at presentation to care and treatment initiation in sub-Saharan Africa, 2002-2013: a meta-  
38 36 analysis. *Clinical infectious diseases: an official publication of the Infectious Diseases  
39 37 Society of America*. 2015;60(7):1120-7.  
40 38  
41 39 30. Egbujie BA, Grimwood A, Mothibi-Wabafor EC, Fatti G, Tshabalala AMET, Allie S, et  
42 40 al. Impact of ‘Ideal Clinic’ implementation on patient waiting time in primary healthcare  
43 41 clinics in KwaZulu-Natal Province, South Africa: A before-and-after evaluation. *SAMJ  
44 42 Research*. 2018;108(4):311-8.

Table 1. Description of ART guideline changes over time in South Africa

| <b>ART Guideline</b>     | <b>Guideline eligibility/description</b>                                                                                     | <b>Introduction of guidelines/directive</b> | <b>Study recruitment period</b> |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|---------------------------------|
| Pre-UTT                  | Eligible for ART start if CD4 <500 cells/ml                                                                                  | January 2015                                | April-December 2015             |
| UTT, before same-day ART | Eligible for ART start if HIV-positive, regardless of CD4 count                                                              | September 2016                              | July-September 2017             |
| UTT, with same-day ART   | Eligible for ART start if HIV-positive, regardless of CD4 count. Directive to initiate ART on date of HIV-positive diagnosis | September 2017                              | October 2017-July 2018          |

1 **Table 2 Characteristics of the sample population by Period of HIV testing**

|                                       | Pre-UTT<br>(n=146) | UTT<br>(n=141) | Same-day ART<br>(n=742) | Total<br>(N=1029) |
|---------------------------------------|--------------------|----------------|-------------------------|-------------------|
|                                       | n (%)              | n (%)          | n (%)                   | n (%)             |
| <b>Facility</b>                       |                    |                |                         |                   |
| PHC1                                  | 68 (46.6)          | 72 (51.1)      | 80 (10.8)               | 220 (21.4)        |
| PHC2                                  | 78 (53.4)          | 69 (48.9)      | 51 (6.9)                | 198 (19.2)        |
| PHC3                                  | -                  | -              | 207 (27.9)              | 207 (20.1)        |
| PHC4                                  | -                  | -              | 125 (16.8)              | 125 (12.1)        |
| PHC5                                  | -                  | -              | 151 (20.4)              | 151 (14.7)        |
| PHC6                                  | -                  | -              | 128 (17.3)              | 128 (12.4)        |
| <b>Time after policy announcement</b> |                    |                |                         |                   |
| ≤3 months                             | 1 (0.7)            | 0              | 138 (18.6)              | 139 (13.5)        |
| 4-6 months                            | 40 (27.4)          | 0              | 183 (24.7)              | 223 (21.7)        |
| 7-9 months                            | 72 (49.3)          | 2 (1.4)        | 233 (31.4)              | 307 (29.8)        |
| ≥10 months                            | 33 (22.6)          | 139 (98.6)     | 188 (25.4)              | 360 (35.0)        |
| <b>Sex</b>                            |                    |                |                         |                   |
| Female                                | 87 (59.6)          | 81 (57.4)      | 461 (62.1)              | 629 (61.1)        |
| Male                                  | 59 (40.4)          | 60 (42.6)      | 281 (37.9)              | 400 (38.9)        |
| <b>Age, (median, IQR)</b>             |                    |                |                         |                   |
| 18 - 24                               | 20 (13.7)          | 20 (14.2)      | 82 (11.1)               | 122 (11.9)        |
| 25 - 29                               | 32 (21.9)          | 33 (23.4)      | 160 (21.6)              | 225 (21.9)        |
| 30 - 34                               | 41 (28.1)          | 29 (20.6)      | 177 (23.9)              | 247 (24.0)        |
| 35 - 39                               | 28 (19.2)          | 31 (22.0)      | 147 (19.8)              | 206 (20.0)        |
| 40+                                   | 25 (17.1)          | 28 (19.9)      | 176 (23.7)              | 229 (22.3)        |
| <b>Baseline CD4</b>                   |                    |                |                         |                   |
| <350                                  | 96 (65.8)          | 73 (51.8)      | 296 (39.9)              | 465 (45.2)        |
| 350 - 500                             | 26 (17.8)          | 22 (15.6)      | 91 (12.3)               | 139 (13.5)        |
| ≥500                                  | 19 (13.0)          | 21 (14.9)      | 97 (13.1)               | 137 (13.3)        |
| Missing                               | 5 (3.4)            | 25 (17.7)      | 258 (34.8)              | 288 (28.0)        |
| <b>Education</b>                      |                    |                |                         |                   |
| < Grade 12                            | 97 (66.4)          | 95 (71.4)      | 544 (73.9)              | 736 (72.5)        |
| ≥ Grade 12                            | 49 (33.6)          | 38 (28.6)      | 192 (26.1)              | 279 (27.5)        |
| <b>Marital Status</b>                 |                    |                |                         |                   |
| Single                                | 28 (19.2)          | 18 (12.8)      | 110 (14.8)              | 156 (15.2)        |
| In a relationship                     | 92 (63.0)          | 98 (69.5)      | 497 (67.1)              | 687 (66.8)        |
| Married                               | 21 (14.4)          | 18 (12.8)      | 112 (15.1)              | 151 (14.7)        |
| Divorced/widowed                      | 5 (3.4)            | 7 (5.0)        | 22 (3.0)                | 34 (3.3)          |
| <b>Employment Status</b>              |                    |                |                         |                   |
| Unemployed                            | 70 (47.9)          | 66 (46.8)      | 402 (54.5)              | 538 (52.5)        |
| Employed                              | 76 (52.1)          | 75 (53.2)      | 335 (45.5)              | 486 (47.5)        |
| <b>Number of adults in household</b>  |                    |                |                         |                   |
| Lives alone                           | 28 (19.2)          | 21 (15.0)      | 160 (21.7)              | 209 (20.5)        |
| Two adult in home                     | 82 (56.2)          | 81 (57.9)      | 429 (58.3)              | 592 (57.9)        |
| ≥ three adults                        | 36 (24.7)          | 38 (27.1)      | 147 (20.0)              | 221 (21.6)        |

**Travel time to clinic**

|               |           |           |            |            |
|---------------|-----------|-----------|------------|------------|
| ≤15 minutes   | 90 (61.6) | 90 (63.8) | 405 (54.6) | 585 (56.9) |
| 16-30 minutes | 46 (31.5) | 45 (31.9) | 224 (30.2) | 315 (30.6) |
| >30 minutes   | 10 (6.8)  | 6 (4.3)   | 113 (15.2) | 129 (12.5) |

**Table 3 Demographic and clinical characteristics associated with initiating ART within 30 days of HIV diagnosis**

|                                       | <b>Initiated ART within 30 days n(%)</b> | <b>Person years</b> | <b>Rates/100 PY (95% CI)</b> | <b>Crude HR (95% CI)</b> | <b>Adjusted HR (95% CI)</b> |
|---------------------------------------|------------------------------------------|---------------------|------------------------------|--------------------------|-----------------------------|
| <b>Facilities</b>                     |                                          |                     |                              |                          |                             |
| PHC 1                                 | 145 (65.9)                               | 1.1                 | 131.6 (111.8-154.8)          | 0.5 (0.4-0.7)            | 1.3 (0.8-2.0)               |
| PHC 2                                 | 96 (48.5)                                | 1.4                 | 66.6 (54.5-81.4)             | 0.3 (0.2-0.4)            | 0.7 (0.4-1.2)               |
| PHC 3                                 | 169 (81.6)                               | 0.7                 | 228.6 (196.6-265.8)          | 0.9 (0.7-1.1)            | 0.8 (0.6-1.0)               |
| PHC 4                                 | 98 (78.4)                                | 0.4                 | 266.7 (218.8-325.1)          | 1                        | 1                           |
| PHC 5                                 | 121 (80.1)                               | 0.6                 | 192.9 (161.4-230.5)          | 0.8 (0.6-1.0)            | 0.7 (0.6-1.0)               |
| PHC 6                                 | 111 (86.7)                               | 0.4                 | 267.8 (222.3-322.5)          | 1.0 (0.7-1.3)            | 0.9 (0.7-1.2)               |
| <b>Guideline periods</b>              |                                          |                     |                              |                          |                             |
| Pre-UTT                               | 54 (36.9)                                | 1.1                 | 45.4 (34.8-59.3)             | 0.3 (0.2-0.3)            | 0.2 (0.1-0.4)               |
| UTT                                   | 93 (65.9)                                | 0.8                 | 117.7 (96.1-144.3)           | 0.6 (0.5-0.7)            | 0.3 (0.2-0.5)               |
| Same-day ART                          | 593 (79.9)                               | 2.7                 | 218.8 (201.7-236.9)          | 1.0                      | 1.0                         |
| <b>Time after policy announcement</b> |                                          |                     |                              |                          |                             |
| ≤3 months                             | 101 (72.7)                               | 0.6                 | 157.4 (129.5-191.3)          | 0.9 (0.7-1.1)            | 0.4 (0.2-0.6)               |
| 4-6 months                            | 152 (68.2)                               | 1.1                 | 133.0 (113.4-155.9)          | 0.8 (0.6-1.0)            | 0.5 (0.4-0.7)               |
| 7-9 months                            | 216 (70.4)                               | 1.4                 | 155.8 (136.3-178.0)          | 0.9 (0.7-1.1)            | 0.7 (0.6-0.8)               |
| ≥10 months                            | 271 (75.3)                               | 1.5                 | 178.3 (158.2-200.8)          | 1                        | 1                           |
| <b>Sex</b>                            |                                          |                     |                              |                          |                             |
| Male                                  | 266 (66.5)                               | 2.0                 | 134.7 (119.4-151.9)          | 1.0                      | 1.0                         |
| Female                                | 474 (75.3)                               | 2.7                 | 174.5 (159.5-190.9)          | 1.7 (1.4-2.0)            | 1.2 (1.0-1.4)               |
| <b>Age at testing</b>                 |                                          |                     |                              |                          |                             |
| 18 - 24                               | 88 (72.1)                                | 0.5                 | 170.9 (138.7-210.6)          | 1.0                      |                             |
| 25 - 29                               | 159 (70.7)                               | 1.1                 | 150.2 (128.6-175.5)          | 0.9 (0.7-1.2)            |                             |
| 30 - 34                               | 170 (68.8)                               | 1.1                 | 154.5 (132.9-179.6)          | 0.9 (0.7-1.2)            |                             |
| 35 - 39                               | 146 (70.8)                               | 1.0                 | 147.5 (125.2-173.1)          | 0.9 (0.7-1.2)            |                             |
| 40+                                   | 177 (77.2)                               | 1.0                 | 171.8 (148-199.9)            | 1.1 (0.8-1.3)            |                             |
| <b>Baseline CD4</b>                   |                                          |                     |                              |                          |                             |
| <350                                  | 146 (62.7)                               | 2.2                 | 154.4 (138.9-171.6)          | 1.0                      | 1.0                         |
| 350 - 500                             | 238 (79.9)                               | 0.6                 | 169.6 (139.8-205.7)          | 1.1 (0.9-1.4)            | 1.1 (0.9-1.3)               |
| ≥500                                  | 172 (81.9)                               | 0.5                 | 217.9 (180.6-262.9)          | 1.3 (1.0-1.6)            | 1.1 (0.9-1.4)               |
| Missing                               | 194 (63.9)                               | 1.4                 | 135.7 (117.5-156.8)          | 0.9 (0.8-1.1)            | 0.6 (0.5-0.7)               |
| <b>Education</b>                      |                                          |                     |                              |                          |                             |
| < Grade 12                            | 527 (71.6)                               | 3.4                 | 154.5 (142.1-168.5)          | 1.0                      |                             |

|                              |            |      |                     |               |               |
|------------------------------|------------|------|---------------------|---------------|---------------|
| ≥ Grade 12                   | 203 (72.7) | 1.2  | 165.0 (144.2-189.9) | 1.1 (0.9-1.2) |               |
| <b>Marital Status</b>        |            |      |                     |               |               |
| Single                       | 114 (73.0) | 0.7  | 160.6 (133.6-192.9) | 1.00          |               |
| In a relationship            | 483 (70.3) | 3.1  | 156.3 (142.6-170.4) | 1.0 (0.8-1.2) |               |
| Married                      | 119 (78.8) | 0.67 | 172.5 (142.7-204.3) | 1.1 (0.8-1.4) |               |
| Divorced/widowed             | 23 (67.6)  | 0.2  | 127.8 (83.1-188.3)  | 0.8 (0.5-1.3) |               |
| <b>Employment Status</b>     |            |      |                     |               |               |
| Unemployed                   | 386 (71.7) | 2.5  | 156.3 (141.2-172.3) | 1.0           |               |
| Employed                     | 351 (72.2) | 2.2  | 161.0 (144.6-178.2) | 1.0 (0.9-1.2) |               |
| <b># adults in household</b> |            |      |                     |               |               |
| Lives alone                  | 141 (67.4) | 1.0  | 138.2 (117.1-162.9) | 1.0           | 1.0           |
| Two adult in home            | 442 (74.6) | 2.6  | 170.0 (154.8-186.5) | 1.2 (1.0-1.4) | 1.2 (1.0-1.5) |
| ≥ three adults               | 153 (69.2) | 1.0  | 148.5 (126.8-174.1) | 1.1 (0.8-1.3) | 1.1 (0.9-1.5) |
| <b>Travel time to clinic</b> |            |      |                     |               |               |
| ≤15 minutes                  | 415 (70.9) | 2.7  | 152.0 (138.2-167.5) | 1.0           | 1.0           |
| 16-30 minutes                | 218 (69.2) | 1.5  | 143.4 (125.4-163.5) | 1.0 (0.8-1.1) | 0.9 (0.8-1.1) |
| >30 minutes                  | 107 (82.9) | 0.4  | 243.2 (200.9-293.5) | 1.5 (1.2-1.8) | 1.1 (0.9-1.5) |

**Table 4 Demographic and clinical characteristics associated with initiating ART on the day of HIV diagnosis**

|                                       | Initiated ART<br>within same-day<br>n(%) | Crude RR<br>(95% CI) | Adjusted<br>RR (95% CI) |
|---------------------------------------|------------------------------------------|----------------------|-------------------------|
| <b>Facility</b>                       |                                          |                      |                         |
| PHC 1                                 | 8 (10.0)                                 | 0.3 (0.2-0.6)        | 1.5 (0.5-4.3)           |
| PHC 2                                 | 9 (17.7)                                 | 0.5 (0.3-1.0)        | 2.1 (0.9-4.9)           |
| PHC 3                                 | 35 (16.9)                                | 0.5 (0.3-0.7)        | 0.7 (0.4-1.0)           |
| PHC 4                                 | 42 (33.6)                                | 1                    | 1                       |
| PHC 5                                 | 46 (30.5)                                | 0.9 (0.6-1.3)        | 1.3 (0.8-1.9)           |
| PHC 6                                 | 10 (7.8)                                 | 0.2 (0.1-0.4)        | 0.3 (0.1-0.5)           |
| <b>Time after policy announcement</b> |                                          |                      |                         |
| ≤3 months                             | 15 (10.9)                                | 0.3 (0.2-0.6)        | 0.2 (0.1-0.4)           |
| 4-6 months                            | 19 (10.4)                                | 0.3 (0.2-0.5)        | 0.3 (0.2-0.5)           |
| 7-9 months                            | 57 (24.5)                                | 0.8 (0.6-1.1)        | 0.8 (0.6-1.0)           |
| ≥10 months                            | 59 (31.4)                                | 1                    | 1                       |
| <b>Sex</b>                            |                                          |                      |                         |
| Male                                  | 44 (15.7)                                | 1                    | 1                       |
| Female                                | 106 (23.0)                               | 1.5 (1.1-2.0)        | 1.3 (1.0-1.9)           |
| <b>Age at testing</b>                 |                                          |                      |                         |
| 18 - 24                               | 25 (30.5)                                | 1.0                  | 1.0                     |

|                              |            |               |               |
|------------------------------|------------|---------------|---------------|
| 25 - 29                      | 37 (23.1)  | 0.8 (0.5-1.2) | 0.8 (0.5-1.3) |
| 30 - 34                      | 38 (21.5)  | 0.7 (0.5-1.1) | 0.8 (0.5-1.2) |
| 35 - 39                      | 24 (16.3)  | 0.5 (0.3-0.9) | 0.7 (0.4-1.1) |
| 40+                          | 26 (14.8)  | 0.5 (0.3-0.8) | 0.6 (0.4-0.9) |
| <b>Baseline CD4</b>          |            |               |               |
| <350                         | 44 (14.9)  | 1.0           | 1.0           |
| 350 - 500                    | 18 (19.8)  | 1.3 (0.8-2.2) | 1.0 (0.4-2.6) |
| ≥500                         | 20 (20.6)  | 1.4 (0.9-2.2) | 1.1 (0.4-2.9) |
| Missing                      | 68 (26.4)  | 1.8 (1.3-2.5) | 1.5 (0.6-3.7) |
| <b>Education</b>             |            |               |               |
| < Grade 12                   | 107 (19.7) | 1.0           |               |
| ≥ Grade 12                   | 43 (22.4)  | 1.1 (0.8-1.6) |               |
| <b>Marital Status</b>        |            |               |               |
| Single                       | 17 (15.5)  | 1.0           |               |
| In a relationship            | 117 (23.5) | 1.5 (0.9-2.4) |               |
| Married                      | 16 (14.3)  | 0.9 (0.5-1.7) |               |
| Divorced/widowed             | 0          |               |               |
| <b>Employment Status</b>     |            |               |               |
| Unemployed                   | 76 (18.9)  | 1.0           |               |
| Employed                     | 72 (21.5)  | 1.1 (0.9-1.5) |               |
| <b># adults in household</b> |            |               |               |
| Lives alone                  | 30 (18.7)  | 1.0           |               |
| Two adult in home            | 88 (20.5)  | 1.1 (0.8-1.6) |               |
| ≥ three adults               | 30 (20.4)  | 1.1 (0.7-1.7) |               |
| <b>Travel time to clinic</b> |            |               |               |
| ≤15 minutes                  | 77 (19.0)  | 1.0           | 1.0           |
| 16-30 minutes                | 41 (18.3)  | 0.9 (0.7-1.4) | 1.1 (0.8-1.6) |
| >30 minutes                  | 32 (28.3)  | 1.5 (1.0-2.1) | 1.3 (0.8-2.0) |

1  
2  
3  
4



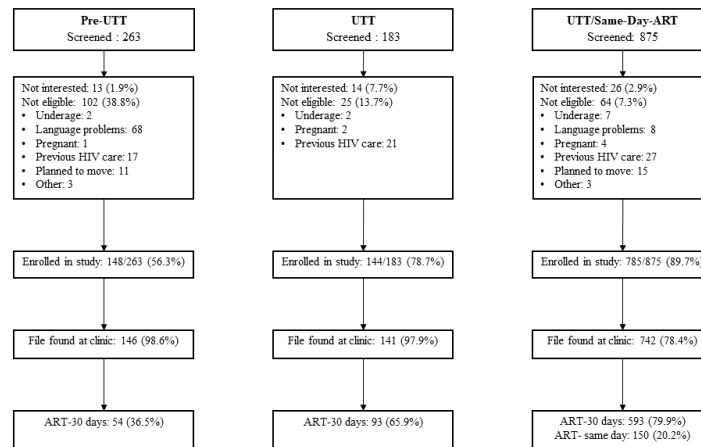


Figure 1. Participant flow through the recruitment process by ART guideline periods

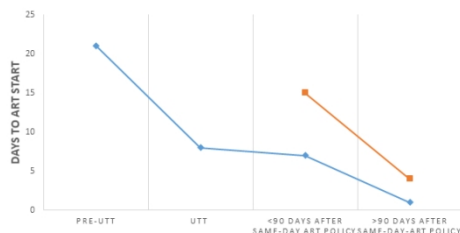


Figure 2. Time to ART initiation in the first 30 days of HIV care pre-UTT, during UTT and under the same-day ART policies in Johannesburg, South Africa.

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

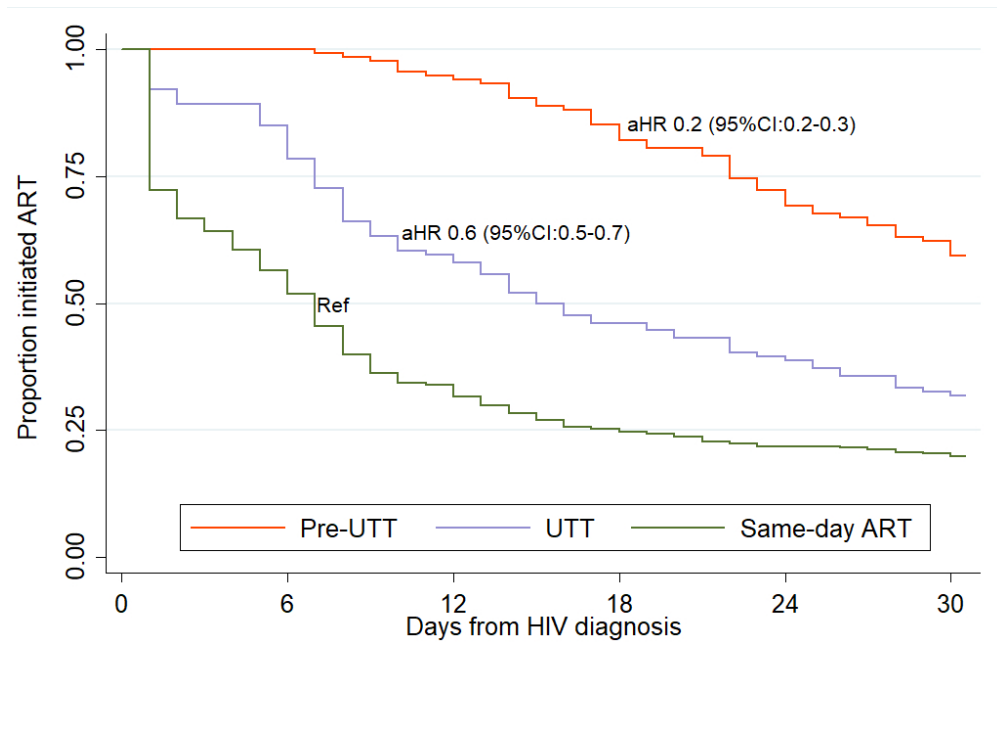


Figure 3. Kaplan Meier curves of ART initiation in the first 30 days of HIV care in Johannesburg, South Africa

361x262mm (72 x 72 DPI)

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

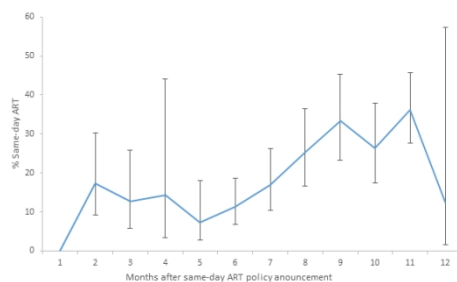


Figure 4. The trend of same-day ART initiations in the first ten months of the same-day ART policy in Johannesburg, South Africa

**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cohort studies**

| Section/Topic             | Item # | Recommendation                                                                                                                                                                       | Reported on page # |
|---------------------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| <b>Title and abstract</b> | 1      | (a) Indicate the study's design with a commonly used term in the title or the abstract                                                                                               | 2-3                |
|                           |        | (b) Provide in the abstract an informative and balanced summary of what was done and what was found                                                                                  |                    |
| <b>Introduction</b>       |        |                                                                                                                                                                                      |                    |
| Background/rationale      | 2      | Explain the scientific background and rationale for the investigation being reported                                                                                                 | 4-5                |
| Objectives                | 3      | State specific objectives, including any prespecified hypotheses                                                                                                                     | 5-6                |
| <b>Methods</b>            |        |                                                                                                                                                                                      |                    |
| Study design              | 4      | Present key elements of study design early in the paper                                                                                                                              | 5-6                |
| Setting                   | 5      | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection                                                      | 5-6                |
| Participants              | 6      | (a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up                                                           | 5-6                |
|                           |        | (b) For matched studies, give matching criteria and number of exposed and unexposed                                                                                                  |                    |
| Variables                 | 7      | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable                                             | 5-6                |
| Data sources/measurement  | 8*     | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 5-6                |
| Bias                      | 9      | Describe any efforts to address potential sources of bias                                                                                                                            | 6-7                |
| Study size                | 10     | Explain how the study size was arrived at                                                                                                                                            |                    |
| Quantitative variables    | 11     | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why                                                         | 6-7                |
| Statistical methods       | 12     | (a) Describe all statistical methods, including those used to control for confounding                                                                                                | 6-7                |
|                           |        | (b) Describe any methods used to examine subgroups and interactions                                                                                                                  | 6-7                |
|                           |        | (c) Explain how missing data were addressed                                                                                                                                          | 6-7                |
|                           |        | (d) If applicable, explain how loss to follow-up was addressed                                                                                                                       |                    |
|                           |        | (e) Describe any sensitivity analyses                                                                                                                                                |                    |
| <b>Results</b>            |        |                                                                                                                                                                                      |                    |

|                          |     |                                                                                                                                                                                                                                                                                                                                                                                                               |                           |
|--------------------------|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| Participants             | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed<br>(b) Give reasons for non-participation at each stage<br>(c) Consider use of a flow diagram                                                                                                               | 6<br>Figure 1<br>Figure 1 |
| Descriptive data         | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders<br>(b) Indicate number of participants with missing data for each variable of interest<br>(c) Summarise follow-up time (eg, average and total amount)                                                                                                                | 6<br>Table 2<br>5-6       |
| Outcome data             | 15* | Report numbers of outcome events or summary measures over time                                                                                                                                                                                                                                                                                                                                                | 6-7                       |
| Main results             | 16  | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included<br>(b) Report category boundaries when continuous variables were categorized<br>(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | <br>6-7, Table 2          |
| Other analyses           | 17  | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses                                                                                                                                                                                                                                                                                                                | Tables 2-4                |
| <b>Discussion</b>        |     |                                                                                                                                                                                                                                                                                                                                                                                                               |                           |
| Key results              | 18  | Summarise key results with reference to study objectives                                                                                                                                                                                                                                                                                                                                                      | 8-10                      |
| <b>Limitations</b>       |     |                                                                                                                                                                                                                                                                                                                                                                                                               |                           |
| Interpretation           | 20  | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence                                                                                                                                                                                                                                    | 10-12                     |
| Generalisability         | 21  | Discuss the generalisability (external validity) of the study results                                                                                                                                                                                                                                                                                                                                         | 10-12                     |
| <b>Other information</b> |     |                                                                                                                                                                                                                                                                                                                                                                                                               |                           |
| Funding                  | 22  | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based                                                                                                                                                                                                                                                 | 13                        |

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Impact of the test and treat policy on delays in ART initiation among HIV positive adult patients from six clinics in Johannesburg, South Africa: results from a prospective cohort study

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Journal:                        | <i>BMJ Open</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Manuscript ID                   | bmjopen-2019-030228.R2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Article Type:                   | Original research                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Date Submitted by the Author:   | 27-Nov-2019                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Complete List of Authors:       | Onoya, Dorina; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office Sineke, Tembeka; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office Hendrickson, Cheryl; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office Mokhele, Idah; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office Maskew, Mhairi; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office Long, Lawrence; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office; Boston University, Boston School of Public Health, Department of Global Health Fox, Matthew; Boston University, Epidemiology and Global Health; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office |
| <b>Primary Subject Heading</b>: | Health policy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Secondary Subject Heading:      | HIV/AIDS, Public health, Health policy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Keywords:                       | HIV & AIDS < INFECTIOUS DISEASES, Public health < INFECTIOUS DISEASES, PRIMARY CARE, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

SCHOLARONE™  
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.



1  
2  
3  
4 **+Working Title:**

5  
6 2 Impact of the test and treat policy on same-day ART delays in HIV treatment initiation in  
7  
8 3 Johannesburg, South Africa

9  
10 4 **Title: Impact of the test and treat policy on delays in ART initiation among HIV positive**  
11 **adult patients from six clinics in Johannesburg, South Africa: results from a prospective**  
12 **cohort study**

13  
14  
15  
16 7 **Authors:** Dorina Onoya<sup>1</sup>, Tembeka Sineke<sup>1</sup>, Cheryl Hendrickson<sup>1</sup>, Idah Mokhele<sup>1</sup>, Mhairi  
17  
18 8 Maskew<sup>1</sup>, Lawrence Long<sup>1,2</sup>, Matthew P. Fox<sup>1,2,3</sup>

19  
20 9 <sup>1</sup> Health Economics and Epidemiology Research Office, Department of Internal Medicine, School  
21  
22 10 of Clinical Medicine, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg,  
23  
24 11 South Africa

25 12 <sup>2</sup> Department of Global Health, Boston University School of Public Health, Boston, MA, USA

26  
27 13 <sup>3</sup> Department of Epidemiology, Boston University School of Public Health, Boston, MA, USA

28  
29  
30 15 **Corresponding author:** Dorina Onoya, Health Economics and Epidemiology Research Office,  
31  
32 16 39 Empire Road, Parktown, Johannesburg, 2193, South Africa, [donoya@heroza.org](mailto:donoya@heroza.org) +27 10 001  
33  
34 17 7930

35  
36 18  
37 19 **Keywords:** HIV, ART attrition, UTT, same-day ART

38  
39 20  
40 21 **Word count (main body):** 3436

42 22

43  
44  
45 23

46  
47 24

48  
49 25

50  
51 26

52  
53  
54 27

## 1 Abstract

2 **Objectives** To assess delays to antiretroviral therapy (ART) initiation before the Universal Test  
3 & Treat (UTT) policy, under UTT and during same-day initiation (SDI) of ART policy periods  
4 in Johannesburg, South Africa.

5 **Design** Prospective cohort study

6 **Setting** Patients were recruited from six primary health clinic in Johannesburg.

7 **Participants** Overall, 1029 newly diagnosed HIV positive adults ( $\geq 18$  years) were consecutively  
8 enrolled by referral from the testing HIV counsellor between April- December 2015 (Pre-UTT  
9  $n=146$ ), July-August 2017 (UTT,  $n=141$ ) and October 2017-August 2018 (SDI,  $n=742$ ).

10 **Main outcome measures** Predictors of 30-days ART initiation uptake were assessed using Cox  
11 proportional hazards models from HIV diagnosis. Additionally, predictors of immediate ART  
12 initiation were evaluated using Poisson regression modelling.

13 **Results** Overall, 30-days ART proportions were 71.9% overall, 36.9% pre-UTT, 65.9% under  
14 UTT and 79.9% under the SDI policy. The median days to ART initiation declined from 21 pre-  
15 UTT (IQR: 15-30) to eight (IQR: 6-16) under UTT and five days (IQR: 0-8) under the SDI  
16 policy. However, only 150 (20.2%) of the SDI cohort initiated ART immediately after HIV  
17 diagnosis. Living in a two-adult home (adjusted Hazard ratio (aHR) 1.2 vs living alone, 95%  
18 Confidence Interval (CI): 1.0-1.4) increased the likelihood of 30-day ART. Missing baseline  
19 CD4 data decreased the likelihood of 30-days ART by 40% (aHR 0.6 vs  $CD4 < 350$  cell/ $\mu$ l, 95%  
20 CI: 0.5-0.7). Women were more likely to take up immediate ART (aRR 1.3, 95%CI: 1.0-1.9).  
21 Participants  $\geq 40$  years (aRR 0.6 vs 18-24 years old, 95% CI: 0.4-0.9) were less likely to start  
22 ART on the day of HIV diagnosis. However, immediate ART rates increased with longer policy  
23 implementation time (aRR 0.2 for  $< 3$ -months vs  $> 10$ -months, 95%CI: 0.1-0.4).

24 **Conclusions** Our results highlight a positive move towards earlier ART initiation during the  
25 UTT and SDI periods and emphasise a need to increase same-day ART implementation further.

26 **Word count: 300**

27

## 1 Strengths and limitations

- 2 • Cohorts enrolled across the three most recent ART guideline implementation periods in  
3 South Africa, allowing observation of changes over time.
- 4 • Participants enrolled immediately after HIV diagnosis, allowing for observation of ART  
5 initiation and patient attrition from HIV diagnosis.
- 6 • Our results highlight a positive move towards earlier initiation of HIV treatment after the  
7 UTT policy implementation.
- 8 • Although we demonstrate substantial reductions in delays to ART initiation (median of 21 to  
9 five days), ART initiation on the day of HIV diagnosis is limited and requires additional  
10 investigations to improve programmatic performance.
- 11 • Increases in missing baseline laboratory tests at diagnosis reduce the strength of laboratory  
12 datasets as monitoring tools for the early steps of the HIV treatment cascade and delay the  
13 assessment of the appropriateness of the initial ART regimen.

## 1 Introduction

2 South Africa has the largest Human Immunodeficiency Virus (HIV) epidemic in the world, with  
3 an estimated 7.9 million persons living with HIV (1). Over the years, the South African  
4 government gradually increased the cluster of differentiation four (CD4)-based antiretroviral  
5 therapy (ART) eligibility threshold from 200 cells/ $\mu$ l in 2004, to 350 cells/ $\mu$ l in 2010 and 500  
6 cells/ $\mu$ l in January 2015 (2-6). These thresholds both capped the number of persons initiating  
7 ART and negatively affected the retention of pre-ART patients. In the past, attrition from care  
8 after HIV diagnosis was also related to the number of assessment and counselling visits required  
9 before treatment initiation for eligible patients and the lack of systematic monitoring of and  
10 benefits for patients who were not offered ART (2-7). Additional pre-ART determinants of  
11 losses from the HIV treatment cascade include gender, requirement for a treatment  
12 buddy/disclosure and HIV stigma, and the high cost of attending clinic visits (7-14).

13 In September 2016, South Africa removed the CD4 cell count threshold for ART eligibility and  
14 adopted the World Health Organization (WHO) 2015 Universal Test and Treat (UTT)  
15 policymaking all HIV positive patients eligible for ART at diagnosis (15-17). Clinical trials  
16 showed that, compared to patients who deferred ART, patients who started treatment  
17 immediately after HIV diagnosis had lower rates of acquired immunodeficiency syndrome  
18 (AIDS)-related adverse events and improved viral suppression rates with no difference in post-  
19 initiation attrition rates (18-22). Moreover, patients who started ART immediately after diagnosis  
20 were less likely to transmit HIV than patients who deferred ART (16, 21-23).

21 In September 2017, the general UTT policy was updated with a directive to initiate ART on the  
22 day of HIV diagnosis (same-day initiation - SDI) (24). While widespread support for the UTT  
23 policy has created momentum for its promulgation, there remained reservations from primary  
24 health care (PHC) providers that health system capacity constraints may limit same-day ART  
25 policy assimilation and result in variations in implementation at facility-level (25). The policy  
26 was implemented amid concerns that, under UTT, health facilities in high burden settings, in  
27 particular, might struggle with the increased patient burden, potentially reducing the quality of  
28 care provided to new and existing patients (2-4, 26-27). There were also concerns around patient  
29 acceptance of same-day ART, ART refusal or early patient disengagement from care or  
30 intermittent adherence after starting ART (28).

1 In 2017, an estimated 4.4 million (55.7%) South African HIV-positive patients had started ART  
2 (1). While this constituted an increase in the number of HIV positive patients initiated on  
3 ART (nearly one million additional patients started ART between 2016 and 2017), the  
4 proportions also suggested continued challenges with patient linkage to ART after HIV diagnosis  
5 (1). Furthermore, in addition to measuring program success in terms of expanded access to ART,  
6 critical outcomes of the UTT policy include the initiation of patients with high CD4 cell count,  
7 reductions in delays to ART initiation and long-term retention in HIV care.

8 In this study, we set out to measure ART initiation of newly diagnosed adults in the first 30 days  
9 of HIV care (30-day ART) across the three recent ART guideline periods and to examine factors  
10 associated with 30-days ART at six primary healthcare clinics (PHC) in Johannesburg, South  
11 Africa. Additionally, we examined rates and factors associated with initiating ART on the day of  
12 HIV diagnosis among participants diagnosed under the SDI policy.

## 14 **Methods**

### 15 *Study Setting and design*

16 The city of Johannesburg (JHB) is the largest of five health districts in the Gauteng province in  
17 South Africa. Johannesburg had an estimated HIV prevalence of 12.9% (>500,000 persons living  
18 with HIV) in 2017, with 60.7% of diagnosed persons currently receiving ART. Johannesburg  
19 comprises 108 PHC (facilities subdivided into seven regions or sub-districts (denoted A-G)  
20 covering about 75% of the population (uninsured). This study was conducted at six (of 13)  
21 conveniently selected public-sector PHCs in the JHB health sub-district A. PHC clinics in  
22 Johannesburg are mainly nurse-run with the support of one medical doctor and are responsible  
23 for HIV testing, ART initiation and primary-level management and monitoring of HIV positive  
24 patients.

25 We conducted a prospective cohort study, enrolling consenting newly diagnosed HIV positive  
26 adult ( $\geq 18$  years) patients from April to December 2015 (CD4<500 or Pre-UTT period), July-  
27 August 2017 (UTT period) and October 2017-August 2018 (SDI period) (Summarised in Table  
28 1). Pre-UTT and UTT cohorts were only enrolled from two PHCs in Johannesburg while the SDI  
29 cohort included four additional PHCs in the same area (serving similar populations) in

1 Johannesburg (Table 2) (11-14). We assumed that 70% of HIV positive patients with CD4  
2 counts > 350 cells/ $\mu$ l would become lost from HIV care in the first year after HIV diagnosis  
3 compared to 60% among patients with CD4  $\leq$  350. We further hypothesised a 20% reduction in  
4 overall attrition between the pre-UTT and UTT periods. Additionally, the sample size for the  
5 SDI cohort was increased to enable a separate assessment of ART refusal (hypothesised 20%  
6 refusal by six-month post-HIV diagnosis) and attrition among participants who initiate ART with  
7 high CD4 count (>500 cells/ $\mu$ l). The ART refusal analysis will be presented in future  
8 manuscript. The number of sites was also increased to six to allow comparison of the same-day  
9 ART across clinics.

10 Participant enrolment co-occurred across sites until 100% sample size was attained at each site  
11 (Figure 1). All patients were enrolled in the study after a new (self-reported) HIV-positive  
12 diagnosis (before ART eligibility determination) by trained study interviewers via referral from  
13 PHC-based lay HIV counsellors. We included newly diagnosed adult patients (18 years or older)  
14 who were able to speak English, Zulu and Sotho. Patients were eligible if they had entered HIV  
15 care after an HIV-positive diagnosis. Entering HIV care was defined as providing the first blood  
16 sample for baseline safety laboratory tests for the Pre-UTT and UTT cohorts, and defined as  
17 having received the HIV positive test result for the same-day ART cohort because new clinic  
18 processes meant that patients were likely to start ART before the first blood collection. Women  
19 who were pregnant at HIV diagnosis were excluded from the study because their antenatal care  
20 ART initiation and monitoring processes differ from that of non-pregnant populations. Study  
21 staff cooperated closely with lay HIV counsellors across sites and checked HIV testing records  
22 daily to ensure that all testers who were diagnosed with HIV were being referred to study staff  
23 for study eligibility assessment.

#### 24 *Data Collection*

25 Patients provided written consent for all study procedures and completed an interviewer-  
26 administered baseline questionnaire after HIV testing, on the day of HIV diagnosis. The consent  
27 process and interviews were conducted exclusively in English in the pre-UTT cohort because we  
28 assumed that the urban Johannesburg population would be conversant in English but later  
29 translated to Sotho and Zulu as well for the UTT and SDI cohorts. The interview included  
30 questions on demographic factors, socioeconomic status and health-seeking behaviour. The

1 recency of the HIV diagnosis was determined from HIV testing history questions at baseline.  
2 Patients were passively followed up by medical record review up to 30 days after HIV diagnosis  
3 to determine ART initiation.

4 Person-time accrued from the date of HIV diagnosis (study enrolment) until ART initiation. We  
5 assumed that all patients for whom clinic files were created were in care for the first 30 days  
6 unless there was evidence of an official transfer or death in the first 30 days after HIV diagnosis.  
7 Trained data collectors captured routine clinical follow-up data of consenting participants from  
8 facility-based paper and electronic medical records, including laboratory test results from the  
9 National Health Laboratory Services (NHLS). We define baseline CD4 as the first CD4 results in  
10 up to 30 days after HIV diagnosis. Trained data collectors captured all routine clinical follow-up  
11 data on the REDCap (Research Electronic Data Capture) systems (Vanderbilt University,  
12 Nashville, Tennessee). All datasets were exported to STATA 14 (StataCorp, College Station,  
13 Texas) for the analysis.

#### 14 *Patient and Public Involvement*

15 Patients of the current study were not directly involved in the design of this study or reimbursed  
16 for their participation in the study. However, information collected from patients in previous  
17 studies informed the design, data collection approaches and interpretation of study results (19,  
18 24). Also, the study implementation was guided by health care workers from the participating  
19 study sites. Study participants consented to a once-off direct data collection after HIV diagnosis  
20 and passive follow-up data collection via medical record review. Therefore, direct result  
21 dissemination to patients will not be possible. However, we plan to present study results to health  
22 care workers and policy-makers at participating PHC clinics and at other policy-relevant forums.

#### 23 *Outcome data and analysis*

24 The primary exposure variable was the ART policy at the time of HIV diagnosis, categorised as  
25 pre-UTT (policy active between January 2015 and August 2016), under the general UTT (active  
26 between September 2016 and August 2017) policy and the SDI policy (active from September  
27 2017 onward) (14, 17, 24). The primary outcome was ART initiation up to 30 days after HIV  
28 diagnosis (30-day ART), and the secondary outcome is ART initiation immediately after HIV

1 diagnosis (Immediate ART), both outcomes were coded Yes (1) or No (0). Final data analysis  
2 began in October 2018.

3 Continuous variables were described using medians and interquartile ranges. Categorical  
4 variables were described using percentages. Kaplan Meier analyses were conducted to assess  
5 time to ART initiation in the first 30 days of HIV care. Predictors of 30-day ART were modelled  
6 using Cox proportional hazards regression, reporting Hazard Ratios (HR). Variables with a p-  
7 value <0.1 in crude analyses were entered in the multivariate model. Schoenfeld residuals were  
8 used to test the assumption of proportional hazards. Interaction terms with time-varying  
9 covariates were created for variables that violated the proportional hazards assumption. Variables  
10 were excluded from the model when the inclusion of the interaction term did not resolve the  
11 proportional hazards assumption violation. Missing data were accounted for by including a 'not  
12 measured/missing' category where necessary. Additionally, predictors of ART initiation on the  
13 day of HIV diagnosis (dichotomised) were evaluated using Poisson Regression modelling,  
14 reporting Relative Risks (RR).

15 All multivariate analyses were adjusted for the time from the period-specific policy  
16 announcement to account for the varying lag periods between policy implementation and  
17 participant enrolment across cohorts. Additionally, we tested the association between the highest  
18 level of education and ART initiation across guideline periods to account for the change in  
19 interview language options. The study protocol was reviewed and approved by the Institutional  
20 Review Boards of the University of Witwatersrand (M141103) in South Africa and Boston  
21 University (H-33516) in the USA.

## 22 23 **Results**

### 24 *Clinical and demographic characteristics at baseline*

25 Although 1167 (100% of target sample) HIV positive adults enrolled in the study, this analysis  
26 was limited to 1029 (88.2%) for whom an outcome could be ascertained (medical data was  
27 available), 146 (98.6%) pre-UTT, 141 (97.9%) under UTT, and 742 (94.5%) under the SDI  
28 policy (Figure 1). The exclusive use of English questionnaires in the pre-UTT cohort was the  
29 most significant reason for participant non-eligibility (25.9% of total screened). However, the  
30 age and gender distributions were similar across cohorts (Median 32.6 years for Pre-UTT,



1 interquartile range (IQR):27.2-37.6; 32.3 years for UTT, IQR: 27.2-38.9; and 32.3 years for SDI,  
2 IQR: 28.4-39.5) (Table 2). Women (Median 32.6 years, IQR: 27.0-37.7) were slightly younger at  
3 HIV diagnosis than men (Median 35.8, IQR: 32.1-41.5) ( $\beta_{\text{female}}$  -3.4, 95%CI: -4.4 to -2.4). The  
4 pre-UTT cohort had a marginally higher proportion of participants who completed grade 12  
5 (33.6%) compared to 28.6% in the UTT and 26.1% in the SDI cohorts. Employment rates were  
6 also similar across cohorts (47.9% pre-UTT, 46.8% UTT and 54.5% SDI).

7 Although the proportion of participants who tested with CD4 count<350/mm<sup>3</sup> decreased from  
8 65.8% pre-UTT to 39.7% in the same-day ART cohort, the percentage of patients with missing  
9 baseline CD4 count results increased from 3.4% to 34.7%, respectively. Among participant who  
10 had CD4 data, the proportion of patient with baseline CD4 count>500 cells/ $\mu$ l did not change  
11 substantially across guideline periods (20.0% during SDI vs 13.5% Pre-UTT, relative risk  
12 (RR)=1.5 (95%CI: 0.9-2.3) and RR=1.3 (95%CI: 0.9-2.4) for SDI vs UTT (18.1%)).

13 Although most participants lived within 15 minutes of the diagnosing clinic (56.9%), a small  
14 proportion reported travelling over 30 minutes to the clinic (12.5% overall, 6.8% pre-UTT, 4.3%  
15 under UTT and 15.2% under SDI policies). Travel time varied across clinics such that <12%  
16 participants from five of the six recruitment sites reported travelling over 30 minutes to the  
17 clinics, but 46.4% of participants from PHC four reported >30-minutes travel time.

18 *Time to ART initiation from HIV diagnosis across guideline periods*

1 Overall, 71.9% participants initiated ART within 30 days of HIV diagnosis, 36.5% pre-UTT  
2 (44.3% of those eligible for ART), 65.9% under UTT and 79.9% in the SDI period (Figure 3).  
3 The overall median days to ART initiation declined from 21 days (IQR: 15-30) to eight days  
4 (IQR: 6-16) after the implementation of the UTT policy. Time to ART start was further reduced  
5 to a median of five days (IQR: 0-8) after the SDI directive was given (Figure 2), with most  
6 reductions observed three months after the SDI policy directive was given to PHCs.

7 Overall, 30-day ART rates increased with increasing lag time from the prevailing (at the time of  
8 participant's HIV diagnosis) policy announcement (adjusted hazard ratio (aHR) 0.4 for  $\leq 3$ -  
9 months vs  $\geq 10$ -months, 95%CI: 0.2-0.6). The highest level of education was not associated with  
10 30-day ART uptake. After adjusting for the facility of diagnosis and lag time from the policy  
11 announcement, pre-UTT participants were 80% less likely to initiate ART in the first 30 days  
12 (aHR 0.2, 95% CI: 0.2-0.4) compared to SDI participants (Table 3). Similarly, patients  
13 diagnosed under the UTT policy were 70% less likely to start ART within 30 days of HIV  
14 diagnosis (aHR 0.3, 95% CI: 0.2-0.5) compared to SDI participants (Figure 3).

15 While women had higher 30-day ART rates compared to men (aHR 1.2, 95%CI: 1.0-1.4), there  
16 was no meaningful difference in the likelihood of 30-days ART initiation across age, marital  
17 status, travel time to the clinic or employment categories. Overall, compared to patients with  
18 baseline CD4<350 cell/ $\mu$ l, participants with baseline CD4>500 cells/ $\mu$ l had similar rates of 30-  
19 day ART. However, participants who were missing baseline CD4 counts were 40% less likely to  
20 start ART within a month (aHR 0.6, 95% CI: 0.5-0.7). Participants who lived in a two-adult  
21 home had higher rates of 30-day ART than those who lived alone (aHR 1.2, 95%CI: 1.0-1.5).  
22 Women were more likely to live with at least one other adult (RR 1.2, 95%CI: 1.1-1.4) compared  
23 to men.

#### 24 *Demographic and clinical characteristics associated with immediate ART initiation within the* 25 *SDI cohort*

26 Within the SDI cohort, 150 (20.2%) participants initiated treatment on the day of HIV diagnosis  
27 (25.3% of those who initiated ART within 30 days). Women were more likely to take up  
28 immediate ART (aRR 1.3, 95%CI: 1.0-1.9) than men. Older participants (aRR 0.6 for patients  
29  $\geq 40$  years old compared to patients in the 18-24 years group, 95% CI: 0.4-0.9) were less likely to  
30 start ART on the day of HIV diagnosis (Table 4). In the SDI period, missing baseline CD4 data

1 did not affect the likelihood of starting ART on the day of HIV diagnosis (aRR 1.5, 95%CI: 0.5-  
2 3.7). We also describe a high variability in SDI policy implementation across sites (Table 4).  
3 However, immediate ART rates increased gradually with longer policy implementation time  
4 (aRR 0.2 for <3 months vs >10 months, 95%CI: 0.1-0.4) (Figure 4).

## 6 Discussion

7 This study highlights a marked reduction in time to ART initiation following the implementation  
8 of the UTT guidelines, decreasing from a median of 21 days to eight days, despite this policy not  
9 including a directive to modify ART initiation times. An additional decline in time to ART start  
10 was also observed after the same-day ART memorandum was sent to clinics. These declines are  
11 consistent with the goals of the WHO HIV treatment guidelines: to initiate patients as early as  
12 possible to achieve better clinical outcomes (15-16).

13 Consistent with previous findings (29), we found a decrease in the proportion of patients  
14 presenting with CD4 <350 cells/ $\mu$ l but little improvement in the CD4>500 cells/ $\mu$ l group  
15 between the pre-UTT and SDI periods. Overall, nearly two-thirds of participants who had  
16 baseline CD4 data were diagnosed with HIV with low CD4 counts (<350 cell/ $\mu$ l). Over a third of  
17 the SDI cohort was missing baseline CD4 data.

18 Missing baseline CD4 data in the SDI cohort could have resulted from the lack of clarity in the  
19 policy with regards to the need or timing of safety blood tests early in the same-day ART policy  
20 implementation or patient impatience with the drawn-out HIV testing and ART initiation  
21 processes on the day of HIV testing (17, 25, 30). It is unclear whether this is a result of the  
22 change in the definition of entry in HIV care (first blood draw vs HIV diagnosis) for the SDI  
23 cohort. However, this increase in missing baseline CD4 was observed from the pre-UTT cohort  
24 to the UTT cohort, at which point clinics already began to reduce time to ART start (to the first  
25 week of care for some patients). Nevertheless, having a missing baseline CD4 was associated  
26 with a reduced likelihood of 30-day ART compared to patients with lower baseline CD4 values.  
27 When we restricted the analysis to the SDI cohort, having a missing CD4 count was associated  
28 with a non-significant increase in immediate ART rates, which possibly also means that patients  
29 diagnosed under the SDI policy may start ART before the first blood draw and defer baseline  
30 CD4 tests. However, this finding requires further exploration.

1  
2  
3 1 Interestingly, participants who lived in a two-adult home rather than alone were more likely to  
4 2 initiate ART within 30 days. However, participants who lived in larger households had similar  
5 3 30-day ART rates to those who lived alone, suggesting persisting fear of confidentiality breaches  
6 4 within homes (5, 9).

7  
8  
9  
10 5 Only 20.2% of patients diagnosed under the SDI policy started ART on the day of diagnosis,  
11 6 highlighting possible facility-level policy assimilation challenges. Rates of immediate ART and  
12 7 30-days ART were also higher among non-pregnant women than men. Immediate ART has been  
13 8 available to South African HIV positive pregnant women since 2013 with relatively few patients  
14 9 or provider acceptability challenges (13, 31-33). However, health provider concerns about the  
15 10 SDI policy for the general population may have affected the pace of the policy implementation  
16 11 (25). In a previous qualitative study, Healthcare providers expressed reservations about the  
17 12 acceptability of immediate ART for the majority of their patients and the feasibility of the  
18 13 strategy considering their current workload (25). However, immediate ART rates steadily  
19 14 increased over time, suggesting improvements policy assimilation, albeit with some variability  
20 15 across sites. While CD4 count did not influence immediate ART uptake, women were younger at  
21 16 HIV diagnosis than men, highlighting the persisting need for consistent efforts to increase early  
22 17 HIV testing and ART initiation younger men (1, 31).

23  
24  
25  
26  
27  
28 18 The strength of these analyses lies in the three prospective cohorts, spanning three ART  
29 19 guideline periods in South Africa, allowing direct observation of the changes in ART uptake  
30 20 over time. This study improves on a possible retrospective review by the collection of extensive  
31 21 personal and contextual data that are not routinely collected. However, the study data are limited  
32 22 by the small number of health facilities assessed, limited information about additional facility-  
33 23 level interventions as well as the contributions by partner organisations in supporting policy  
34 24 assimilation and implementation. Therefore, a more representative facility survey is needed to  
35 25 better explain the facility-level variations in ART policy implementation and outcomes.

36  
37  
38  
39 26 Additionally, we only collected ART initiation data from testing facilities with a short follow-up  
40 27 period and were not able to determine if some participants went on to start ART elsewhere.

41  
42  
43  
44  
45  
46 28 Furthermore, the reason for the higher ART uptake among same-day ART participants require  
47 29 further exploration around the ART initiation processes and their potential impact on patients'  
48 30 future health-seeking behaviour as well as long term on-ART outcomes. The sample size did

1 influence the duration of the enrolment process. However, the date of enrolment start depended  
2 on ethics approval. Unfortunately, we were negatively affected by university student protests that  
3 caused the Human Research Ethics department to stop operations for a while, resulting in a  
4 backlog of applications. To compensate for this, we adjusted all multivariate analyses by the lag  
5 period between the policy directive to the clinics and the date of patient's HIV diagnosis.

## 6 7 **Conclusion**

8 Our results highlight a positive move towards earlier ART initiation after the implementation of  
9 the UTT and SDI policies. However, the results also emphasise a vital need to not only  
10 streamline processes to increase immediate ART implementation/uptake further but also ensure  
11 timeous baseline safety and monitoring blood tests. Going forward, the need to improve patient  
12 demand for early HIV testing remains pertinent to achieve the prevention and treatment benefits  
13 of ART.

## 14 15 **Acknowledgements**

16 We extend our gratitude to the staff of PHC clinics who supported the implementation of the  
17 study and our sincere thanks go to the patients attending these clinics for their willingness to  
18 participate and share the valuable information that made this study possible.

## 19 **Author Contributions**

20 DO and MPF conceptualized the study and paper. TS managed the study implementation and  
21 conducted the primary data analysis. TS, CH, IM, implemented the study and contributed to the  
22 result interpretation. LL and MM contributed to the interpretation of the results. All authors  
23 reviewed and approved the manuscript.

## 24 25 **Conflict of Interest**

26 Authors have no conflicts of interest to declare.  
27

## 1 Funding

2 This study has been made possible by the generous support of the American People and the  
3 President's Emergency Plan for AIDS Relief (PEPFAR) through United States Agency for  
4 International Development (USAID) under the terms of Cooperative Agreements AID-674-A-  
5 12-00029 and 72067419CA00004 to HE2RO. The contents are the responsibility of the authors  
6 and do not necessarily reflect the views of PEPFAR, USAID or the United States Government.  
7

## 8 Data Statement

9 Patient medical records are owned by the study site and the National Department of Health  
10 (South Africa) and governed by the Human Research Ethics Committee (University of  
11 Witwatersrand, Johannesburg, South Africa). All relevant data is included in the paper.  
12

## 13 References

- 14  
15 1. HSRC. The Fifth South African National HIV Prevalence, Incidence, Behaviour and  
16 Communication Survey, 2017: HIV Impact Assessment Summary Report. Cape Town,  
17 HSRC Press.; 2017.  
18
- 19 2. Boyer S, Iwuji C, Gosset A, Protopopescu C, Okesola N, Plazy M, et al. Factors  
20 associated with antiretroviral treatment initiation amongst HIV-positive individuals linked  
21 to care within a universal test and treat programme: early findings of the ANRS 12249  
22 TasP trial in rural South Africa. *AIDS Care*. 2016;28(sup3):39-51.  
23
- 24 3. Collins S, Geffen N. Community views: balancing the public health benefits of earlier  
25 antiretroviral treatment with the implications for individual patients – perspectives from  
26 the community. *Current Opinion in HIV and AIDS*. 2014;9(1):4-10.  
27
- 28 4. Cassim N, Coetzee LM, Schnippel K, Glencross DK. Estimating Implementation and  
29 Operational Costs of an Integrated Tiered CD4 Service including Laboratory and Point of  
30 Care Testing in a Remote Health District in South Africa. *PLoS ONE*.  
31 2014;9(12):e115420.  
32
- 33 5. Human Sciences Research Council (HSRC). The People Living With HIV Stigma Index:  
34 South Africa 2014. HSRC Press: 2014 Accessed October 2018  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60
- 1 <http://www.stigmaindex.org/sites/default/files/reports/Summary-Booklet-on-Stigma-Index-Survey%20South%20Africa.pdf>
  - 2
  - 3
  - 4
  - 5
  - 6
  - 7
  - 8
  - 9
  - 10
  - 11
  - 12
  - 13
  - 14
  - 15
  - 16
  - 17
  - 18
  - 19
  - 20
  - 21
  - 22
  - 23
  - 24
  - 25
  - 26
  - 27
  - 28
  - 29
  - 30
  - 31
  - 32
  - 33
  - 34
  - 35
  - 36
  - 37
  - 38
  - 39
  - 40
  - 41
  - 42
  - 43
  - 44
  - 45
  - 46
  - 47
  - 48
  - 49
  - 50
  - 51
  - 52
  - 53
  - 54
  - 55
  - 56
  - 57
  - 58
  - 59
  - 60
6. [Goudge J, Ngoma B, Manderson L, Schneider H. Stigma, identity and resistance among people living with HIV in South Africa. SAHARA-J: Journal of Social Aspects of HIV/AIDS. 2009;6\(3\):94-104.](#)
7. Ahmed S, Autrey J, Katz IT, Fox MP, Rosen S, Onoya D, et al. Why do people living with HIV not initiate treatment? A systematic review of qualitative evidence from low- and middle-income countries. *Social Science & Medicine*. 2018;213:72-84.
8. [Abrahams N, Jewkes R. Managing and resisting stigma: a qualitative study among people living with HIV in South Africa. Journal of the International AIDS Society. 2012 Apr;15\(2\):10-7448.](#)
9. Treves-Kagan S, Steward WT, Ntswane L, Haller R, Gilvydis JM, Gulati H, Barnhart S, Lippman SA. Why increasing availability of ART is not enough: a rapid, community-based study on how HIV-related stigma impacts engagement to care in rural South Africa. *BMC public health*. 2015 Dec;16(1):87.
10. South African National Department of Health (SA-NDoH). National Antiretroviral Treatment Guidelines, 2004. Pretoria: SA-NDoH;2004.
11. South African National Department of Health (SA-NDoH). National Antiretroviral Treatment Guidelines, 2010. Pretoria: SA-NDoH;2010.
12. South African National Department of Health (SA-NDoH). Circular on new criteria for initiating adults on ART at CD4 count of 350 cells/ml and below 2011. Pretoria: SA-NDoH; 2011.
13. South African National Department of Health (SA-NDoH). National Antiretroviral Treatment Guidelines 2013. Pretoria: SA NDoH;2013.
14. South African National Department of Health (SA-NDoH). National Consolidated Guidelines for the prevention of mother-to-child transmission of HIV (PMTCT) and the management of HIV in children, adolescents and adults 2015: SA NDoH;2015.
15. Abuelezam N N, McCormick AW, Fussell T, Afriyie AN, Wood R, DeGruttola V, et al. Can the Heterosexual HIV Epidemic be Eliminated in South Africa Using Combination Prevention? A Modeling Analysis. *American journal of epidemiology*. 2016;184(3):239-48.
16. Eaton JW, Johnson LF, Salomon JA, Bärnighausen T, Bendavid E, Bershteyn A, et al. HIV Treatment as Prevention: Systematic Comparison of Mathematical Models of the

- 1  
2  
3 1 Potential Impact of Antiretroviral Therapy on HIV Incidence in South Africa. PLOS  
4 2 Medicine. 2012;9(7):e1001245.  
5 3  
6 4  
7 4 17. South African National Department of Health (South Africa). Implementation of  
8 5 Universal Test and Treat Strategy for HIV positive patients and differentiated care for  
9 6 stable patients 2016. Pretoria: National Department of Health, 2016.  
10 7 <https://sahivsoc.org/Files/22%208%2016%20Circular%20UTT%20%20%20Decongestio>  
11 8 [n%20CCMT%20Directorate.pdf](https://sahivsoc.org/Files/22%208%2016%20Circular%20UTT%20%20%20Decongestio)  
12 9 Accessed October 2018  
13  
14 10  
15 10 18. Group TAS, Danel C, Moh R, Gabillard D, Badje A, Le Carrou J, et al. A Trial of Early  
16 11 Antiretrovirals and Isoniazid Preventive Therapy in Africa. The New England journal of  
17 12 medicine. 2015;373(9):808-22.  
18 13  
19 14 19. Lundgren JD, Babiker AG, Gordin F, Emery S, Grund B, Sharma S, et al. Initiation of  
20 15 Antiretroviral Therapy in Early Asymptomatic HIV Infection. N Engl J Med.  
21 16 2015;373(9):795-807.  
22 17  
23 18 20. Rosen S, Maskew M, Fox MP, Nyoni C, Mongwenyana C, Maletse G. Initiating  
24 19 Antiretroviral Therapy for HIV at a Patient's First Clinic Visit: The RapIT Randomized  
25 20 Controlled Trial. 2016;13(5):e1002015.  
26 21  
27 22 21. INSIGHT START Study Group, Lundgren JD, Babiker AG, et al. Initiation of  
28 23 Antiretroviral Therapy in Early Asymptomatic HIV Infection. New England Journal of  
29 24 Medicine. 2015;373(9):795-807.  
30 25  
31 26 22. Cohen MS, Chen YQ, McCauley M, Gamble T, Hosseinipour MC, Kumarasamy N,  
32 27 Hakim JG, Kumwenda J, Grinsztejn B, Pilotto JH, Godbole SV. Prevention of HIV-1  
33 28 infection with early antiretroviral therapy. New England journal of medicine. 2011 Aug  
34 29 11;365(6):493-505.  
35 30  
36 31 23. Tanser F, Bärnighausen T, Grapsa E, Zaidi J, Newell ML. High coverage of ART  
37 32 associated with decline in risk of HIV acquisition in rural KwaZulu-Natal, South Africa.  
38 33 Science. 2013 Feb 22;339(6122):966-71..  
39 34  
40 35 24. South African National Department of Health (South Africa). Tracking implementation of  
41 36 the 90-90-90 strategy for HIV, through the implementation of Test and Treat (TT) policy  
42 37 and same-day anti-retroviral therapy (ART) initiation for HIV positive patients 2017.  
43 38 Pretoria: National Department of Health; 2017.  
44 39  
45 40 25. Onoya D, Mokhele I, Sineke T, Ngoma B, Moolla A, Vujovic M, Bor J, Langa J, Fox M  
46 41 P. Health provider perspectives on implementation of same-day ART initiation six months  
47 42 after policy change in South Africa. International AIDS Conference (poster); 2018;  
48 43 Amsterdam.



- 1  
2  
3 1  
4  
5 2 26. Kulkarni SP, Shah KR, Sarma KV, Mahajan AP. Clinical Uncertainties, Health Service  
6 3 Challenges, and Ethical Complexities of HIV “Test-and-Treat”: A Systematic Review.  
7 4 American Journal of Public Health. 2013;103(6):e14-e23.  
8 5  
9  
10 6 27. Skhosana M, Reddy S, Reddy T, Ntoyanto S, Spooner E, Ramjee G, et al. PIMA TM  
11 7 point-of-care testing for CD4 counts in predicting antiretroviral initiation in HIV-infected  
12 8 individuals in KwaZulu-Natal, Durban, South Africa. Southern African Journal of HIV  
13 9 Medicine.2016;17(1).  
14 10  
15 11 28. Bigna JJR, Plottel CS, Koulla-Shiro S. Challenges in initiating antiretroviral therapy for  
16 12 all HIV-infected people regardless of CD4 cell count. Infectious Diseases of Poverty.  
17 13 2016;5(1):85.  
18 14  
19 15 29. Siedner MJ, Ng CK, Bassett IV, Katz IT, Bangsberg DR, Tsai AC. Trends in CD4 count  
20 16 at presentation to care and treatment initiation in sub-Saharan Africa, 2002-2013: a meta-  
21 17 analysis. Clinical infectious diseases: an official publication of the Infectious Diseases  
22 18 Society of America. 2015;60(7):1120-7.  
23 19  
24 20 30. Egbujie BA, Grimwood A, Mothibi-Wabafor EC, Fatti G, Tshabalala AMET, Allie S, et  
25 21 al. Impact of ‘Ideal Clinic’ implementation on patient waiting time in primary healthcare  
26 22 clinics in KwaZulu-Natal Province, South Africa: A before-and-after evaluation. SAMJ  
27 23 Research. 2018;108(4):311-8.  
28 24  
29 25 31. Langwenya N, Phillips TK, Brittain K, Zerbe A, Abrams EJ, Myer L. Same-day  
30 26 antiretroviral therapy (ART) initiation in pregnancy is not associated with viral  
31 27 suppression or engagement in care: A cohort study. Journal of the International AIDS  
32 28 Society. 2018;21(6):e25133.  
33 29  
34 30 32. Garrett N, Norman E, Leask K, Naicker N, Asari V, Majola N, et al. Acceptability of  
35 31 Early Antiretroviral Therapy Among South African Women. AIDS Behav.  
36 32 2018;22(3):1018-24.  
37 33  
38 34 33. Black S, Zulliger R, Marcus R, Mark D, Myer L, Bekker L-G. Acceptability and  
39 35 challenges of rapid ART initiation among pregnant women in a pilot programme, Cape  
40 36 Town, South Africa. AIDS Care. 2014;26(6):736-41.  
41 37  
42 38 34.  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

2 Table 1. Description of ART guideline changes over time in South Africa

| ART Guidelines  | Guideline eligibility/description                                                                                    | Introduction of guidelines/directive | Study recruitment period |
|-----------------|----------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------------------|
| Pre-UTT         | Eligible for ART start if CD4 <500 cells/ml                                                                          | January 2015                         | April-December 2015      |
| UTT, before SDI | Eligible for ART upon HIV-positive diagnosis, regardless of CD4 count                                                | September 2016                       | July-August 2017         |
| UTT + SDI       | Eligible for ART upon HIV-positive diagnosis, regardless of CD4 count. Initiate ART on day of HIV-positive diagnosis | September 2017                       | October 2017-August 2018 |

4 Table 2 Characteristics of the sample population by Period of HIV testing

|                                       | Pre-UTT<br>N=146 |                  | UTT<br>N=141 |                  | SDI<br>N=742 |                  | Total<br>N=1029 |                  |
|---------------------------------------|------------------|------------------|--------------|------------------|--------------|------------------|-----------------|------------------|
|                                       | n                | % (95%CI)        | n            | % (95%CI)        | n            | % (95%CI)        | n               | % (95%CI)        |
| <b>Facility</b>                       |                  |                  |              |                  |              |                  |                 |                  |
| PHC1                                  | 68               | 46.6 (38.6-54.8) | 72           | 51.1 (42.8-59.3) | 80           | 10.8 (8.7-13.2)  | 220             | 21.4 (18.9-23.9) |
| PHC2                                  | 78               | 53.4 (45.2-61.4) | 69           | 48.9 (40.7-57.2) | 51           | 6.9 (5.2-8.9)    | 198             | 19.2 (16.9-21.8) |
| PHC3                                  | -                | -                | -            | -                | 207          | 27.9 (24.8-31.2) | 207             | 20.1 (17.7-22.7) |
| PHC4                                  | -                | -                | -            | -                | 125          | 16.8 (14.3-19.7) | 125             | 12.1 (10.3-14.3) |
| PHC5                                  | -                | -                | -            | -                | 151          | 20.3 (17.6-23.4) | 151             | 14.6 (12.6-16.9) |
| PHC6                                  | -                | -                | -            | -                | 128          | 17.3 (14.7-20.1) | 128             | 12.4 (10.6-14.6) |
| <b>Time after policy announcement</b> |                  |                  |              |                  |              |                  |                 |                  |
| ≤3 months                             | 1                | 0.6 (0.09-4.8)   | 0            | 0                | 138          | 18.6 (15.9-21.6) | 139             | 13.5 (11.5-15.7) |
| 4-6 months                            | 40               | 27.4 (20.7-35.3) | 0            | 0                | 183          | 24.6 (21.7-27.9) | 223             | 21.6 (19.3-24.3) |
| 7-9 months                            | 72               | 49.3 (41.2-57.5) | 2            | 1.4 (0.3-5.6)    | 233          | 31.4 (28.2-34.8) | 307             | 29.8 (27.1-32.7) |
| ≥10 months                            | 33               | 22.6 (16.5-30.2) | 139          | 98.6 (94.4-99.7) | 188          | 25.3 (22.3-28.6) | 360             | 34.9 (32.1-37.9) |
| <b>Sex</b>                            |                  |                  |              |                  |              |                  |                 |                  |
| Female                                | 87               | 40.4 (32.7-48.7) | 81           | 42.6 (34.6-50.9) | 461          | 37.8 (34.4-41.4) | 629             | 38.9 (35.9-41.9) |
| Male                                  | 59               | 59.6 (51.3-67.3) | 60           | 57.4 (49.1-65.4) | 281          | 62.1 (58.6-65.6) | 400             | 61.1 (58.1-64.1) |
| <b>Age (median, IQR)</b>              |                  |                  |              |                  |              |                  |                 |                  |
| Median (IQR)                          |                  | 32.6 (27.2-37.6) |              | 32.8 (27.238.9)  |              | 33.3 (28.4-33.3) |                 | 33.2 (28.2-39.3) |
| 18 - 24                               | 20               | 13.7 (8.9-20.4)  | 20           | 14.2 (9.2-21.1)  | 82           | 10.9 (8.7-13.4)  | 122             | 11.8 (9.9-13.9)  |
| 25 - 29                               | 32               | 21.9 (15.9-29.4) | 33           | 23.4 (17.1-31.2) | 160          | 21.6 (18.7-24.7) | 225             | 21.9 (19.4-24.5) |
| 30 - 34                               | 41               | 28.1 (21.3-36.0) | 29           | 20.6 (14.6-28.1) | 177          | 23.9 (20.9-27.1) | 247             | 24.0 (21.5-26.7) |
| 35 - 39                               | 28               | 19.2 (13.5-26.5) | 31           | 21.9 (15.8-29.7) | 147          | 19.8 (17.1-22.8) | 206             | 20.0 (17.7-22.6) |
| 40+                                   | 25               | 17.1 (11.8-24.2) | 28           | 19.9 (14.0-27.4) | 176          | 23.8 (20.9-27.1) | 229             | 22.3 (19.9-25.0) |
| <b>Baseline CD4</b>                   |                  |                  |              |                  |              |                  |                 |                  |

|                                      |    |                  |    |                  |     |                  |     |                  |
|--------------------------------------|----|------------------|----|------------------|-----|------------------|-----|------------------|
| <350                                 | 96 | 65.7 (57.6-73.1) | 73 | 51.8 (43.5-59.9) | 296 | 39.9 (36.4-43.5) | 465 | 45.1 (42.2-48.2) |
| 350 - 500                            | 26 | 17.8 (12.4-24.9) | 22 | 15.6 (10.4-22.7) | 91  | 12.3 (10.1-14.8) | 139 | 13.5 (11.5-15.7) |
| ≥500                                 | 19 | 13.0 (8.4-19.6)  | 21 | 14.9 (9.8-21.9)  | 97  | 13.1 (10.8-15.7) | 137 | 13.3 (11.4-15.5) |
| Missing                              | 5  | 3.4 (1.4-8.0)    | 25 | 17.7 (12.2-25.0) | 258 | 34.8 (31.4-38.3) | 288 | 27.9 (25.3-30.8) |
| <b>Education</b>                     |    |                  |    |                  |     |                  |     |                  |
| < Grade 12                           | 97 | 66.4 (58.3-73.7) | 95 | 71.4 (63.1-78.5) | 544 | 73.9 (70.6-76.9) | 736 | 72.5 (69.7-75.2) |
| ≥ Grade 12                           | 49 | 33.5 (26.3-41.7) | 38 | 28.6 (21.5-36.9) | 192 | 26.1 (23.0-29.4) | 279 | 27.5 (24.8-30.3) |
| <b>Marital Status</b>                |    |                  |    |                  |     |                  |     |                  |
| Single                               | 28 | 19.2 (13.5-26.5) | 18 | 12.8 (8.1-19.4)  | 110 | 14.8 (12.5-17.6) | 156 | 15.1 (13.1-17.5) |
| In a relationship                    | 92 | 63.0 (54.8-70.5) | 98 | 69.5 (61.3-76.6) | 497 | 67.1 (63.6-70.4) | 687 | 66.8 (63.9-69.6) |
| Married                              | 21 | 14.4 (9.5-21.1)  | 18 | 12.8 (8.1-19.4)  | 112 | 15.1 (12.7-17.9) | 151 | 14.7 (12.7-16.9) |
| Divorced/widowed                     | 5  | 3.4 (1.4-8.0)    | 7  | 4.9 (2.4-10.1)   | 22  | 2.9 (1.9-4.5)    | 34  | 3.3 (2.3-4.5)    |
| <b>Employment Status</b>             |    |                  |    |                  |     |                  |     |                  |
| Unemployed                           | 70 | 25.0 (16.4-36.2) | 66 | 46.8 (38.6-55.2) | 402 | 54.5 (50.9-58.1) | 538 | 52.5 (49.5-55.6) |
| Employed                             | 76 | 75.0 (63.8-83.6) | 75 | 53.2 (44.8-61.4) | 335 | 45.5 (41.9-49.1) | 486 | 47.5 (44.4-50.5) |
| <b>Number of adults in household</b> |    |                  |    |                  |     |                  |     |                  |
| Lives alone                          | 28 | 19.2 (13.5-26.5) | 21 | 15.0 (9.9-22.0)  | 160 | 21.7 (18.9-24.9) | 209 | 20.4 (18.1-23.0) |
| Two adult in home                    | 82 | 56.2 (47.9-64.1) | 81 | 57.9 (49.4-65.8) | 429 | 58.3 (54.7-61.8) | 592 | 57.9 (54.9-60.9) |
| ≥ three adults                       | 36 | 24.7 (18.3-32.4) | 38 | 27.1 (20.4-35.2) | 147 | 19.9 (17.2-23.0) | 221 | 21.6 (19.2-24.3) |
| <b>Travel time to clinic</b>         |    |                  |    |                  |     |                  |     |                  |
| ≤15 minutes                          | 90 | 61.6 (53.4-69.3) | 90 | 63.8 (55.5-71.4) | 405 | 54.6 (50.9-58.1) | 585 | 56.8 (53.8-59.9) |
| 16-30 minutes                        | 46 | 31.5 (24.4-39.6) | 45 | 31.9 (24.7-40.1) | 224 | 30.2 (26.9-33.6) | 315 | 30.6 (27.9-33.5) |
| >30 minutes                          | 10 | 6.8 (3.6-12.3)   | 6  | 4.3 (1.9-9.2)    | 113 | 15.2 (12.8-18.0) | 129 | 12.5 (10.6-14.7) |

**Table 3 Demographic and clinical characteristics associated with initiating ART within 30 days of HIV diagnosis**

|                                       | 30-days ART n(%) | Person years | Incidence rates/100 PY (95% CI) | Crude HR (95% CI) | Adjusted HR (95% CI) |
|---------------------------------------|------------------|--------------|---------------------------------|-------------------|----------------------|
| <b>Facilities</b>                     |                  |              |                                 |                   |                      |
| PHC 1                                 | 145 (65.9)       | 1.1          | 131.6 (111.8-154.8)             | 0.5 (0.4-0.7)     | 1.3 (0.8-2.0)        |
| PHC 2                                 | 96 (48.5)        | 1.4          | 66.6 (54.5-81.4)                | 0.3 (0.2-0.4)     | 0.7 (0.4-1.2)        |
| PHC 3                                 | 169 (81.6)       | 0.7          | 228.6 (196.6-265.8)             | 0.9 (0.7-1.1)     | 0.8 (0.6-1.0)        |
| PHC 4                                 | 98 (78.4)        | 0.4          | 266.7 (218.8-325.1)             | 1                 | 1                    |
| PHC 5                                 | 121 (80.1)       | 0.6          | 192.9 (161.4-230.5)             | 0.8 (0.6-1.0)     | 0.7 (0.6-1.0)        |
| PHC 6                                 | 111 (86.7)       | 0.4          | 267.8 (222.3-322.5)             | 1.0 (0.7-1.3)     | 0.9 (0.7-1.2)        |
| <b>Guideline periods</b>              |                  |              |                                 |                   |                      |
| Pre-UTT                               | 54 (36.9)        | 1.1          | 45.4 (34.8-59.3)                | 0.3 (0.2-0.3)     | 0.2 (0.1-0.4)        |
| UTT                                   | 93 (65.9)        | 0.8          | 117.7 (96.1-144.3)              | 0.6 (0.5-0.7)     | 0.3 (0.2-0.5)        |
| Same-day ART                          | 593 (79.9)       | 2.7          | 218.8 (201.7-236.9)             | 1.0               | 1.0                  |
| <b>Time after policy announcement</b> |                  |              |                                 |                   |                      |
| ≤3 months                             | 101 (72.7)       | 0.6          | 157.4 (129.5-191.3)             | 0.9 (0.7-1.1)     | 0.4 (0.2-0.6)        |
| 4-6 months                            | 152 (68.2)       | 1.1          | 133.0 (113.4-155.9)             | 0.8 (0.6-1.0)     | 0.5 (0.4-0.7)        |
| 7-9 months                            | 216 (70.4)       | 1.4          | 155.8 (136.3-178.0)             | 0.9 (0.7-1.1)     | 0.7 (0.6-0.8)        |

|    |                              |            |      |                     |               |               |
|----|------------------------------|------------|------|---------------------|---------------|---------------|
| 1  |                              |            |      |                     |               |               |
| 2  |                              |            |      |                     |               |               |
| 3  | ≥10 months                   | 271 (75.3) | 1.5  | 178.3 (158.2-200.8) | 1             | 1             |
| 4  | <b>Sex</b>                   |            |      |                     |               |               |
| 5  | Male                         | 266 (66.5) | 2.0  | 134.7 (119.4-151.9) | 1.0           | 1.0           |
| 6  | Female                       | 474 (75.3) | 2.7  | 174.5 (159.5-190.9) | 1.7 (1.4-2.0) | 1.2 (1.0-1.4) |
| 7  |                              |            |      |                     |               |               |
| 8  | <b>Age at testing</b>        |            |      |                     |               |               |
| 9  | 18 - 24                      | 88 (72.1)  | 0.5  | 170.9 (138.7-210.6) | 1.0           |               |
| 10 | 25 - 29                      | 159 (70.7) | 1.1  | 150.2 (128.6-175.5) | 0.9 (0.7-1.2) |               |
| 11 | 30 - 34                      | 170 (68.8) | 1.1  | 154.5 (132.9-179.6) | 0.9 (0.7-1.2) |               |
| 12 | 35 - 39                      | 146 (70.8) | 1.0  | 147.5 (125.2-173.1) | 0.9 (0.7-1.2) |               |
| 13 | 40+                          | 177 (77.2) | 1.0  | 171.8 (148-199.9)   | 1.1 (0.8-1.3) |               |
| 14 |                              |            |      |                     |               |               |
| 15 | <b>Baseline CD4</b>          |            |      |                     |               |               |
| 16 | <350                         | 146 (62.7) | 2.2  | 154.4 (138.9-171.6) | 1.0           | 1.0           |
| 17 | 350 - 500                    | 238 (79.9) | 0.6  | 169.6 (139.8-205.7) | 1.1 (0.9-1.4) | 1.1 (0.9-1.3) |
| 18 | ≥500                         | 172 (81.9) | 0.5  | 217.9 (180.6-262.9) | 1.3 (1.0-1.6) | 1.1 (0.9-1.4) |
| 19 | Missing                      | 194 (63.9) | 1.4  | 135.7 (117.5-156.8) | 0.9 (0.8-1.1) | 0.6 (0.5-0.7) |
| 20 |                              |            |      |                     |               |               |
| 21 | <b>Education</b>             |            |      |                     |               |               |
| 22 | < Grade 12                   | 527 (71.6) | 3.4  | 154.5 (142.1-168.5) | 1.0           |               |
| 23 | ≥ Grade 12                   | 203 (72.7) | 1.2  | 165.0 (144.2-189.9) | 1.1 (0.9-1.2) |               |
| 24 |                              |            |      |                     |               |               |
| 25 | <b>Marital Status</b>        |            |      |                     |               |               |
| 26 | Single                       | 114 (73.0) | 0.7  | 160.6 (133.6-192.9) | 1.00          |               |
| 27 | In a relationship            | 483 (70.3) | 3.1  | 156.3 (142.6-170.4) | 1.0 (0.8-1.2) |               |
| 28 | Married                      | 119 (78.8) | 0.67 | 172.5 (142.7-204.3) | 1.1 (0.8-1.4) |               |
| 29 | Divorced/widowed             | 23 (67.6)  | 0.2  | 127.8 (83.1-188.3)  | 0.8 (0.5-1.3) |               |
| 30 |                              |            |      |                     |               |               |
| 31 | <b>Employment Status</b>     |            |      |                     |               |               |
| 32 | Unemployed                   | 386 (71.7) | 2.5  | 156.3 (141.2-172.3) | 1.0           |               |
| 33 | Employed                     | 351 (72.2) | 2.2  | 161.0 (144.6-178.2) | 1.0 (0.9-1.2) |               |
| 34 |                              |            |      |                     |               |               |
| 35 | <b># adults in household</b> |            |      |                     |               |               |
| 36 | Lives alone                  | 141 (67.4) | 1.0  | 138.2 (117.1-162.9) | 1.0           | 1.0           |
| 37 | Two adult in home            | 442 (74.6) | 2.6  | 170.0 (154.8-186.5) | 1.2 (1.0-1.4) | 1.2 (1.0-1.5) |
| 38 | ≥ three adults               | 153 (69.2) | 1.0  | 148.5 (126.8-174.1) | 1.1 (0.8-1.3) | 1.1 (0.9-1.5) |
| 39 |                              |            |      |                     |               |               |
| 40 | <b>Travel time to clinic</b> |            |      |                     |               |               |
| 41 | ≤15 minutes                  | 415 (70.9) | 2.7  | 152.0 (138.2-167.5) | 1.0           | 1.0           |
| 42 | 16-30 minutes                | 218 (69.2) | 1.5  | 143.4 (125.4-163.5) | 1.0 (0.8-1.1) | 0.9 (0.8-1.1) |
| 43 | >30 minutes                  | 107 (82.9) | 0.4  | 243.2 (200.9-293.5) | 1.5 (1.2-1.8) | 1.1 (0.9-1.5) |

1

2 **Table 4 Demographic and clinical characteristics associated with initiating ART on the day of HIV**  
3 **diagnosis**

|                 | Immediate ART<br>n(%) | Crude RR<br>(95% CI) | Adjusted<br>RR (95% CI) |
|-----------------|-----------------------|----------------------|-------------------------|
| <b>Facility</b> |                       |                      |                         |
| PHC 1           | 8 (10.0)              | 0.3 (0.2-0.6)        | 1.5 (0.5-4.3)           |

20

|                                       |            |               |               |
|---------------------------------------|------------|---------------|---------------|
| PHC 2                                 | 9 (17.7)   | 0.5 (0.3-1.0) | 2.1 (0.9-4.9) |
| PHC 3                                 | 35 (16.9)  | 0.5 (0.3-0.7) | 0.7 (0.4-1.0) |
| PHC 4                                 | 42 (33.6)  | 1             | 1             |
| PHC 5                                 | 46 (30.5)  | 0.9 (0.6-1.3) | 1.3 (0.8-1.9) |
| PHC 6                                 | 10 (7.8)   | 0.2 (0.1-0.4) | 0.3 (0.1-0.5) |
| <b>Time after policy announcement</b> |            |               |               |
| ≤3 months                             | 15 (10.9)  | 0.3 (0.2-0.6) | 0.2 (0.1-0.4) |
| 4-6 months                            | 19 (10.4)  | 0.3 (0.2-0.5) | 0.3 (0.2-0.5) |
| 7-9 months                            | 57 (24.5)  | 0.8 (0.6-1.1) | 0.8 (0.6-1.0) |
| ≥10 months                            | 59 (31.4)  | 1             | 1             |
| <b>Sex</b>                            |            |               |               |
| Male                                  | 44 (15.7)  | 1             | 1             |
| Female                                | 106 (23.0) | 1.5 (1.1-2.0) | 1.3 (1.0-1.9) |
| <b>Age at testing</b>                 |            |               |               |
| 18 - 24                               | 25 (30.5)  | 1.0           | 1.0           |
| 25 - 29                               | 37 (23.1)  | 0.8 (0.5-1.2) | 0.8 (0.5-1.3) |
| 30 - 34                               | 38 (21.5)  | 0.7 (0.5-1.1) | 0.8 (0.5-1.2) |
| 35 - 39                               | 24 (16.3)  | 0.5 (0.3-0.9) | 0.7 (0.4-1.1) |
| 40+                                   | 26 (14.8)  | 0.5 (0.3-0.8) | 0.6 (0.4-0.9) |
| <b>Baseline CD4</b>                   |            |               |               |
| <350                                  | 44 (14.9)  | 1.0           | 1.0           |
| 350 - 500                             | 18 (19.8)  | 1.3 (0.8-2.2) | 1.0 (0.4-2.6) |
| ≥500                                  | 20 (20.6)  | 1.4 (0.9-2.2) | 1.1 (0.4-2.9) |
| Missing                               | 68 (26.4)  | 1.8 (1.3-2.5) | 1.5 (0.6-3.7) |
| <b>Education</b>                      |            |               |               |
| < Grade 12                            | 107 (19.7) | 1.0           |               |
| ≥ Grade 12                            | 43 (22.4)  | 1.1 (0.8-1.6) |               |
| <b>Marital Status</b>                 |            |               |               |
| Single                                | 17 (15.5)  | 1.0           |               |
| In a relationship                     | 117 (23.5) | 1.5 (0.9-2.4) |               |
| Married                               | 16 (14.3)  | 0.9 (0.5-1.7) |               |
| Divorced/widowed                      | 0          |               |               |
| <b>Employment Status</b>              |            |               |               |
| Unemployed                            | 76 (18.9)  | 1.0           |               |
| Employed                              | 72 (21.5)  | 1.1 (0.9-1.5) |               |
| <b># adults in household</b>          |            |               |               |
| Lives alone                           | 30 (18.7)  | 1.0           |               |
| Two adult in home                     | 88 (20.5)  | 1.1 (0.8-1.6) |               |
| ≥ three adults                        | 30 (20.4)  | 1.1 (0.7-1.7) |               |
| <b>Travel time to clinic</b>          |            |               |               |
| ≤15 minutes                           | 77 (19.0)  | 1.0           | 1.0           |

|               |           |               |               |
|---------------|-----------|---------------|---------------|
| 16-30 minutes | 41 (18.3) | 0.9 (0.7-1.4) | 1.1 (0.8-1.6) |
| >30 minutes   | 32 (28.3) | 1.5 (1.0-2.1) | 1.3 (0.8-2.0) |

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

26

27

28

29

30

31

32

33

34

35

36

37

38

39

40

41

42

43

44

45

46

47

48

49

50

51

52

53

54

55

56

57

58

59

60

**Figure 1. Participants flow from screening to ART initiation in the first 30 days of care by ART policy periods**

**Figure 2. Time to ART start in the first 30 days of HIV care by ART policy periods**

**Figure 3. Kaplan Meier curve of ART initiation in the first 30 days of HIV care by ART policy periods**

**Figure 4. Immediate ART uptake in the first 12 months of the SDI policy implementation**

For peer review only

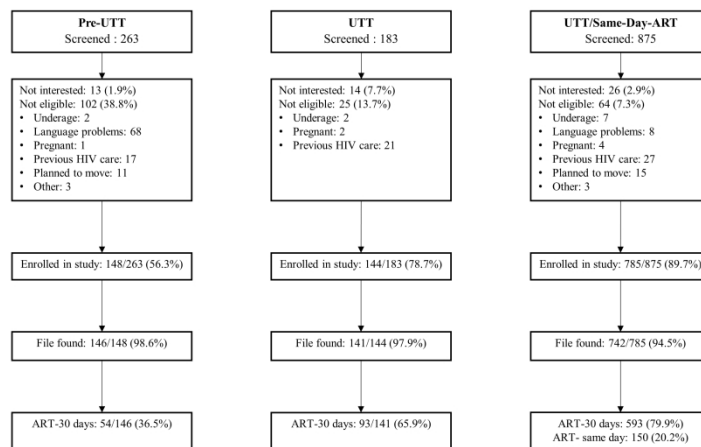


Figure 1. Participants flow from screening to ART initiation in the first 30 days of care by ART policy periods

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

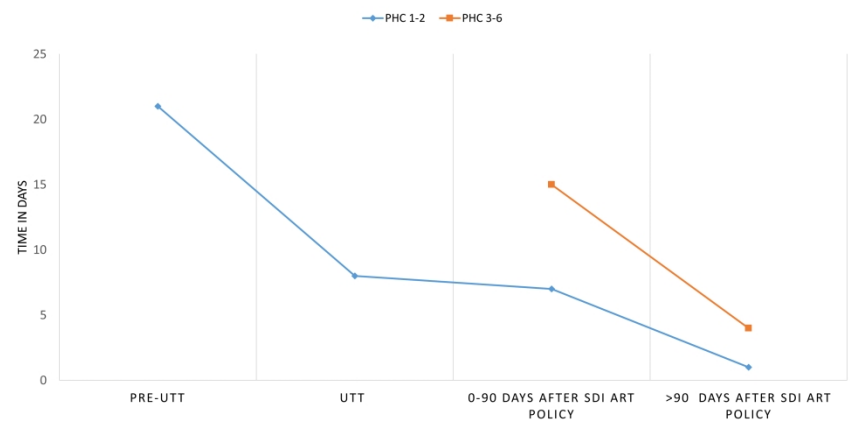


Figure 2. Time to ART start in the first 30 days of HIV care by ART policy periods



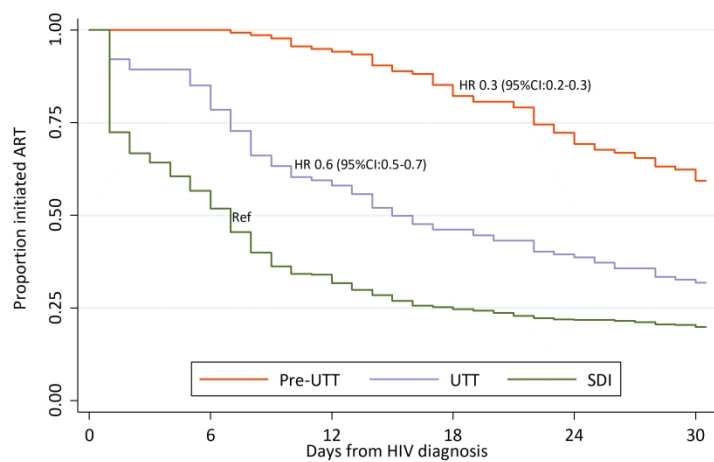


Figure 3. Kaplan Meier curve of ART initiation in the first 30 days of HIV care by ART policy periods

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

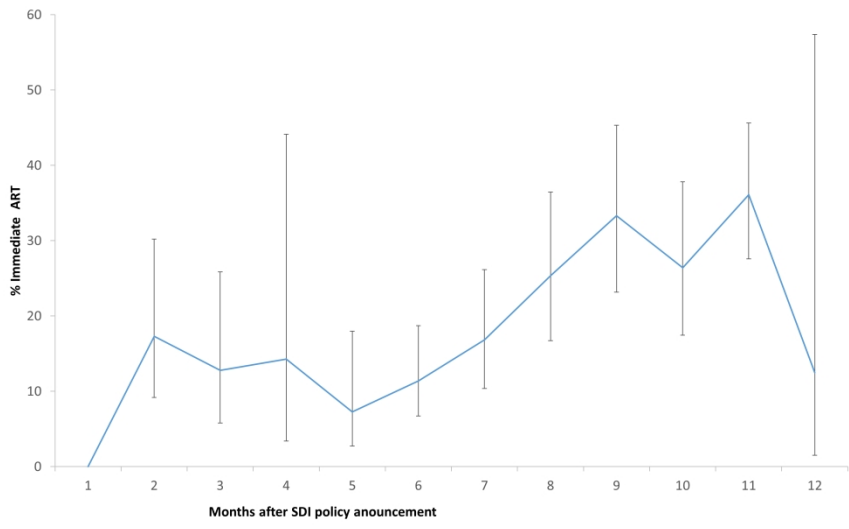


Figure 4. Immediate ART uptake in the first 12 months of the SDI policy implementation

**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cohort studies**

| Section/Topic                | Item # | Recommendation                                                                                                                                                                       | Reported on page # |
|------------------------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| <b>Title and abstract</b>    | 1      | (a) Indicate the study's design with a commonly used term in the title or the abstract                                                                                               | 2-3                |
|                              |        | (b) Provide in the abstract an informative and balanced summary of what was done and what was found                                                                                  |                    |
| <b>Introduction</b>          |        |                                                                                                                                                                                      |                    |
| Background/rationale         | 2      | Explain the scientific background and rationale for the investigation being reported                                                                                                 | 4-5                |
| Objectives                   | 3      | State specific objectives, including any prespecified hypotheses                                                                                                                     | 5-6                |
| <b>Methods</b>               |        |                                                                                                                                                                                      |                    |
| Study design                 | 4      | Present key elements of study design early in the paper                                                                                                                              | 5-6                |
| Setting                      | 5      | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection                                                      | 5-6                |
| Participants                 | 6      | (a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up                                                           | 5-6                |
|                              |        | (b) For matched studies, give matching criteria and number of exposed and unexposed                                                                                                  |                    |
| Variables                    | 7      | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable                                             | 5-6                |
| Data sources/<br>measurement | 8*     | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 5-6                |
| Bias                         | 9      | Describe any efforts to address potential sources of bias                                                                                                                            | 6-7                |
| Study size                   | 10     | Explain how the study size was arrived at                                                                                                                                            |                    |
| Quantitative variables       | 11     | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why                                                         | 6-7                |
| Statistical methods          | 12     | (a) Describe all statistical methods, including those used to control for confounding                                                                                                | 6-7                |
|                              |        | (b) Describe any methods used to examine subgroups and interactions                                                                                                                  | 6-7                |
|                              |        | (c) Explain how missing data were addressed                                                                                                                                          | 6-7                |
|                              |        | (d) If applicable, explain how loss to follow-up was addressed                                                                                                                       |                    |
|                              |        | (e) Describe any sensitivity analyses                                                                                                                                                |                    |
| <b>Results</b>               |        |                                                                                                                                                                                      |                    |

|                          |     |                                                                                                                                                                                                                                                                                                                                                                                                               |                           |
|--------------------------|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| Participants             | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed<br>(b) Give reasons for non-participation at each stage<br>(c) Consider use of a flow diagram                                                                                                               | 6<br>Figure 1<br>Figure 1 |
| Descriptive data         | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders<br>(b) Indicate number of participants with missing data for each variable of interest<br>(c) Summarise follow-up time (eg, average and total amount)                                                                                                                | 6<br>Table 2<br>5-6       |
| Outcome data             | 15* | Report numbers of outcome events or summary measures over time                                                                                                                                                                                                                                                                                                                                                | 6-7                       |
| Main results             | 16  | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included<br>(b) Report category boundaries when continuous variables were categorized<br>(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | 6-7, Table 2              |
| Other analyses           | 17  | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses                                                                                                                                                                                                                                                                                                                | Tables 2-4                |
| <b>Discussion</b>        |     |                                                                                                                                                                                                                                                                                                                                                                                                               |                           |
| Key results              | 18  | Summarise key results with reference to study objectives                                                                                                                                                                                                                                                                                                                                                      | 8-10                      |
| <b>Limitations</b>       |     |                                                                                                                                                                                                                                                                                                                                                                                                               |                           |
| Interpretation           | 20  | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence                                                                                                                                                                                                                                    | 10-12                     |
| Generalisability         | 21  | Discuss the generalisability (external validity) of the study results                                                                                                                                                                                                                                                                                                                                         | 10-12                     |
| <b>Other information</b> |     |                                                                                                                                                                                                                                                                                                                                                                                                               |                           |
| Funding                  | 22  | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based                                                                                                                                                                                                                                                 | 13                        |

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Impact of the test and treat policy on delays in antiretroviral therapy initiation among adult HIV positive patients from six clinics in Johannesburg, South Africa: results from a prospective cohort study

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Journal:                        | <i>BMJ Open</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Manuscript ID                   | bmjopen-2019-030228.R3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Article Type:                   | Original research                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Date Submitted by the Author:   | 05-Feb-2020                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Complete List of Authors:       | Onoya, Dorina; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office Sineke, Tembeka; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office Hendrickson, Cheryl; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office Mokhele, Idah; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office Maskew, Mhairi; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office Long, Lawrence; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office; Boston University, Boston School of Public Health, Department of Global Health Fox, Matthew; Boston University, Epidemiology and Global Health |
| <b>Primary Subject Heading</b>: | Health policy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Secondary Subject Heading:      | HIV/AIDS, Public health, Health policy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Keywords:                       | HIV & AIDS < INFECTIOUS DISEASES, Public health < INFECTIOUS DISEASES, PRIMARY CARE, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

SCHOLARONE™  
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

1  
2  
3  
4 **+Working Title:**

5  
6 2 Impact of the test and treat policy on delays in HIV treatment initiation in Johannesburg, South  
7  
8 3 Africa

9  
10 4 **Title: Impact of the test and treat policy on delays in antiretroviral therapy initiation among**  
11 **adult HIV positive patients from six clinics in Johannesburg, South Africa: results from a**  
12 **prospective cohort study**  
13  
14 6

15  
16 7 **Authors:** Dorina Onoya<sup>1</sup>, Tembeka Sineke<sup>1</sup>, Cheryl Hendrickson<sup>1</sup>, Idah Mokhele<sup>1</sup>, Mhairi  
17  
18 8 Maskew<sup>1</sup>, Lawrence Long<sup>1,2</sup>, Matthew P. Fox<sup>1,2,3</sup>

19  
20 9 <sup>1</sup> Health Economics and Epidemiology Research Office, Department of Internal Medicine, School  
21  
22 10 of Clinical Medicine, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg,  
23  
24 11 South Africa

25 12 <sup>2</sup> Department of Global Health, Boston University School of Public Health, Boston, MA, USA

26  
27 13 <sup>3</sup> Department of Epidemiology, Boston University School of Public Health, Boston, MA, USA  
28  
29 14

30 15 **Corresponding author:** Dorina Onoya, Health Economics and Epidemiology Research Office,  
31  
32 16 39 Empire Road, Parktown, Johannesburg, 2193, South Africa, [donoya@heroza.org](mailto:donoya@heroza.org) +27 10 001  
33  
34 17 7930

35  
36 18  
37 19 **Keywords:** HIV, ART attrition, UTT, same-day ART  
38  
39 20

40  
41 21 **Word count (main body):** 3436  
42  
43 22  
44  
45 23  
46  
47 24  
48  
49 25  
50  
51 26  
52  
53 27  
54  
55  
56  
57  
58  
59  
60

## 1 Abstract

2 **Objectives** To assess delays to antiretroviral therapy (ART) initiation before and after the  
3 Universal Test & Treat (UTT) and the same-day initiation (SDI) of ART policy periods in  
4 Johannesburg, South Africa.

5 **Design** Prospective cohort study

6 **Setting** Patients were recruited from six primary health clinics in Johannesburg.

7 **Participants** Overall, 1029 newly diagnosed HIV positive adults ( $\geq 18$  years) were consecutively  
8 enrolled by referral from the testing counsellor between April- December 2015 (Pre-UTT  
9  $n=146$ ), July-August 2017 (UTT,  $n=141$ ) and October 2017-August 2018 (SDI,  $n=742$ ).

10 **Main outcome measures** Cox proportional hazards regression was used to assess predictors of  
11 30-days ART initiation. Additionally, predictors of immediate ART initiation were evaluated  
12 using Poisson regression.

13 **Results** Overall, 30-days ART proportions were 71.9% overall, 36.9% pre-UTT (44.3% of those  
14 eligible), 65.9% under UTT and 79.9% under the SDI policy. The median days to ART initiation  
15 declined from 21 pre-UTT (Interquartile range (IQR): 15-30) to eight (IQR: 6-16) under UTT  
16 and five days (IQR: 0-8) under the SDI policy. However, only 150 (20.2%) of the SDI cohort  
17 initiated ART immediately after HIV diagnosis. Living in a two-adult home (adjusted Hazard  
18 ratio (aHR) 1.2 vs living alone, 95% Confidence Interval (CI): 1.0-1.5) increased the likelihood  
19 of 30-day ART. Missing baseline CD4 data decreased the likelihood of 30-days ART by 40%  
20 (aHR 0.6 vs  $CD4 < 350$  cell/ $\mu$ l, 95% CI: 0.5-0.7). More women took up immediate ART (adjusted  
21 relative risk (aRR) 1.3, 95%CI: 1.0-1.9). Participants  $\geq 40$  years (aRR 0.6 vs 18-24 years, 95%  
22 CI: 0.4-0.9) were less likely to start ART immediately after HIV diagnosis. However, immediate  
23 ART rates increased with longer policy implementation time (aRR 0.2 for  $< 3$ -months vs  $> 10$ -  
24 months, 95%CI: 0.1-0.4).

25 **Conclusions** The study results highlight a positive move towards earlier ART initiation during  
26 the UTT and SDI periods and emphasise a need to increase same-day ART implementation  
27 further.

28 **Word count: 300**



1

## 2 Strengths and limitations

- 3 • Cohorts enrolled across the three most recent ART guideline implementation periods in  
4 South Africa, allowing observation of changes over time.
- 5 • Participants were enrolled immediately after HIV diagnosis, allowing for observation of ART  
6 initiation and patient attrition from HIV diagnosis over time.
- 7 • The results highlight a positive move towards earlier initiation of HIV treatment after the  
8 UTT policy implementation.
- 9 • Although we demonstrate substantial reductions in delays to ART initiation (median of 21 to  
10 five days), ART initiation on the day of HIV diagnosis is limited and requires additional  
11 investigations to improve programmatic performance.
- 12 • Increases in missing baseline laboratory tests at diagnosis reduce the strength of laboratory  
13 datasets as monitoring tools for the early steps of the HIV treatment cascade and delay the  
14 assessment of the appropriateness of the initial ART regimen.

15

16

17

18

19

## 1 Introduction

2 South Africa has the largest Human Immunodeficiency Virus (HIV) epidemic in the world, with  
3 an estimated 7.9 million persons living with HIV (1). Over the years, the South African  
4 government gradually increased the cluster of differentiation four (CD4)-based antiretroviral  
5 therapy (ART) eligibility threshold from 200 cells/ $\mu$ l in 2004, to 350 cells/ $\mu$ l in 2010 and 500  
6 cells/ $\mu$ l in January 2015 (2-6). These thresholds both capped the number of persons initiating  
7 ART and negatively affected the retention of pre-ART patients. In the past, attrition from care  
8 after HIV diagnosis was also related to the number of assessment and counselling visits required  
9 before treatment initiation for eligible patients and the lack of systematic monitoring of and  
10 benefits for patients who were not offered ART (2-7). Additional pre-ART determinants of  
11 losses from the HIV treatment cascade include gender, requirement for a treatment  
12 buddy/disclosure and HIV stigma, and the high cost of attending clinic visits (7-14).

13 In September 2016, South Africa removed the CD4 cell count threshold for ART eligibility and  
14 adopted the World Health Organization (WHO) 2015 Universal Test and Treat (UTT) policy,  
15 making all HIV positive patients eligible for ART at diagnosis (15-17). Clinical trials showed  
16 that, compared to patients who deferred ART, patients who started treatment immediately after  
17 HIV diagnosis had lower rates of acquired immunodeficiency syndrome (AIDS)-related adverse  
18 events and improved viral suppression rates with no difference in post-initiation attrition rates  
19 (18-22). Moreover, patients who started ART immediately after diagnosis were less likely to  
20 transmit HIV than patients who deferred ART (16, 21-23).

21 In September 2017, the general UTT policy was updated with a directive to initiate ART on the  
22 day of HIV diagnosis (same-day initiation - SDI) (24). While widespread support for the UTT  
23 policy has created momentum for its promulgation, there remained reservations from primary  
24 health care (PHC) providers that health system capacity constraints may limit same-day ART  
25 policy assimilation and result in variations in implementation at facility-level (25). The policy  
26 was implemented amid concerns that, under UTT, health facilities in high burden settings, in  
27 particular, might struggle with the increased patient burden, potentially reducing the quality of  
28 care provided to new and existing patients (2-4, 26-27). There were also concerns around patient  
29 acceptance of same-day ART, ART refusal or early patient disengagement from care or  
30 intermittent adherence after starting ART (28).

1 In 2017, an estimated 4.4 million (55.7%) South African HIV-positive patients had started ART  
2 (1). While this constituted a major increase in the number of HIV positive patients initiated on  
3 ART (nearly one million additional patients started ART between 2016 and 2017), the  
4 proportions also suggested continued challenges with patient linkage to ART after HIV diagnosis  
5 (1). Furthermore, in addition to measuring program success in terms of expanded access to ART,  
6 critical outcomes of the UTT policy include the initiation of patients with high CD4 (>500)  
7 count, reductions in delays to ART initiation and long-term retention in HIV care.

8 In this study, we set out to measure ART initiation of newly HIV diagnosed adults in the first 30  
9 days of HIV care (30-day ART) across the three recent ART guideline periods and examine  
10 factors associated with 30-days ART at six primary healthcare clinics (PHC) in Johannesburg,  
11 South Africa. Additionally, we examined rates and predictors of initiating ART on the day of  
12 HIV diagnosis among patients diagnosed under the SDI policy.

## 14 **Methods**

### 15 *Study Setting and design*

16 The city of Johannesburg is the largest of five health districts in the Gauteng province in South  
17 Africa. Johannesburg had an estimated HIV prevalence of 12.9% (>500,000 persons living with  
18 HIV) in 2017, with 60.7% of diagnosed persons currently receiving ART. Johannesburg  
19 comprises 108 PHCs subdivided into seven regions or sub-districts (denoted A-G) covering  
20 about 75% of the population (mainly uninsured). This study was conducted at six (of 13)  
21 conveniently selected public-sector PHCs in the Johannesburg health sub-district A. PHCs in  
22 Johannesburg are mainly nurse-run with the support of one medical doctor and are responsible  
23 for HIV testing, ART initiation and primary-level management and monitoring of HIV positive  
24 patients.

25 We conducted a prospective cohort study, enrolling consenting newly diagnosed HIV positive  
26 adult ( $\geq 18$  years) patients from April to December 2015 (CD4<500 or Pre-UTT period), July-  
27 August 2017 (UTT period) and October 2017-August 2018 (SDI period) (Summarised in Table  
28 1). Pre-UTT and UTT cohorts were only enrolled from two PHCs in Johannesburg while the SDI  
29 cohort included four additional PHCs serving similar populations in the same area in

1 Johannesburg (Table 2) (11-14). We assumed that 70% of HIV positive patients with CD4  
2 counts > 350 cells/ $\mu$ l would become lost from HIV care in the first year after HIV diagnosis  
3 compared to 60% among patients with CD4  $\leq$  350. We further hypothesised a 20% reduction in  
4 overall attrition between the pre-UTT and UTT periods. Additionally, the sample size for the  
5 SDI cohort was increased to enable a separate assessment of ART refusal (hypothesised 20%  
6 refusal by six-month post-HIV diagnosis) and attrition among participants who initiate ART with  
7 high CD4 count (>500 cells/ $\mu$ l). The ART refusal analysis will be presented in future  
8 manuscripts. The number of sites was also increased to six to allow comparison of the same-day  
9 ART across clinics.

10 Participant enrolment co-occurred across sites until 100% sample size was attained at each site  
11 (Figure 1). All patients were enrolled in the study after a new (self-reported) HIV-positive  
12 diagnosis (before ART eligibility determination) by trained study interviewers via referral from  
13 PHC-based lay HIV counsellors. We included newly diagnosed adult patients (18 years or older)  
14 who were able to speak English, Zulu and Sotho. Patients were eligible if they had entered HIV  
15 care after an HIV-positive diagnosis. Entering HIV care was defined as providing the first blood  
16 sample for baseline safety laboratory tests for the Pre-UTT and UTT cohorts, and defined as  
17 having received the HIV positive test result for the same-day ART cohort because new clinic  
18 processes meant that patients were likely to start ART before the first blood collection. The first  
19 blood tests were necessary to determine patients' CD4 count eligibility for ART and the  
20 appropriate initial ART regiment, hence the term "safety bloods". Women who were pregnant at  
21 HIV diagnosis were excluded from the study because ART initiation and monitoring processes in  
22 antenatal care differ from that of non-pregnant populations. Study staff cooperated closely with  
23 lay HIV counsellors across sites and checked HIV testing records daily to ensure that all testers  
24 who were diagnosed with HIV were being referred to study staff for study eligibility assessment.

### 25 *Data Collection*

26 Patients provided written consent for all study procedures and completed an interviewer-  
27 administered baseline questionnaire after HIV testing, on the day of HIV diagnosis. The consent  
28 process and interviews were conducted exclusively in English in the pre-UTT cohort because we  
29 assumed that the urban Johannesburg population would be conversant in English but later  
30 translated to Sotho and Zulu as well for the UTT and SDI cohorts. The interview included

1 questions on demographic factors, socioeconomic status and health-seeking behaviour. The  
2 recency of the HIV diagnosis was determined from HIV testing history questions at baseline.  
3 Patients were passively followed up by paper and electronic (including laboratory data) medical  
4 record review up to 30 days after HIV diagnosis to determine ART initiation.

5 Person-time accrued from the date of HIV diagnosis (study enrolment) until ART initiation. We  
6 assumed that all patients for whom clinic files were created were in care for the first 30 days  
7 unless there was evidence of an official transfer or death in the first 30 days after HIV diagnosis.  
8 Trained data collectors captured routine clinical follow-up data of consenting participants from  
9 facility-based paper and electronic medical records, including laboratory test results from the  
10 National Health Laboratory Services (NHLS). We define baseline CD4 as the first CD4 results in  
11 up to 30 days after HIV diagnosis. Trained data collectors captured all routine clinical follow-up  
12 data on the REDCap (Research Electronic Data Capture) systems (Vanderbilt University,  
13 Nashville, Tennessee). All datasets were exported to STATA 14 (StataCorp, College Station,  
14 Texas) for the analysis.

#### 15 *Patient and Public Involvement*

16 Patients of the current study were not directly involved in the design of this study or reimbursed  
17 for their participation in the study. However, information collected from patients in previous  
18 studies informed the design, data collection approaches and interpretation of study results (19,  
19 24). Also, the study implementation was guided by health care workers from the participating  
20 study sites. Study participants consented to a once-off direct data collection after HIV diagnosis  
21 and passive follow-up data collection via medical record review. Therefore, direct result  
22 dissemination to patients will not be possible. However, we plan to present study results to health  
23 care workers and policy-makers at participating PHC clinics and at other policy-relevant forums.

#### 24 *Outcome data and analysis*

25 The primary exposure variable was the ART policy period at the time of HIV diagnosis,  
26 categorised as pre-UTT (policy active between January 2015 and August 2016), under the  
27 general UTT (active between September 2016 and August 2017) policy and the SDI policy  
28 (active from September 2017 onward) (14, 17, 24). The primary outcome was ART initiation up  
29 to 30 days after HIV diagnosis (30-day ART), and the secondary outcome is ART initiation

1 immediately after HIV diagnosis (Immediate ART), both outcomes were coded Yes (1) or No  
2 (0). Final data analysis began in October 2018.

3 Continuous variables were described using medians and interquartile ranges. Categorical  
4 variables were described using percentages. Kaplan Meier analyses were conducted to assess  
5 time to ART initiation in the first 30 days of HIV care. Predictors of 30-day ART were modelled  
6 using Cox proportional hazards regression, reporting Hazard Ratios (HR). Variables with a p-  
7 value <0.1 in crude analyses were entered in the multivariate model. Schoenfeld residuals were  
8 used to test the assumption of proportional hazards. Interaction terms with time-varying  
9 covariates were created for variables that violated the proportional hazards assumption. Variables  
10 were excluded from the model when the inclusion of the interaction term did not resolve the  
11 proportional hazards assumption violation. Missing data were accounted for by including a 'not  
12 measured/missing' category where necessary. Additionally, predictors of ART initiation on the  
13 day of HIV diagnosis (dichotomised) were evaluated using Poisson Regression modelling,  
14 reporting Relative Risks (RR).

15 All multivariate analyses were adjusted for the time from the period-specific policy  
16 announcement to account for the varying lag periods between policy implementation and  
17 participant enrolment (policy-months at HIV diagnosis) across cohorts. Additionally, we tested  
18 the association between the highest level of education and ART initiation across guideline  
19 periods to account for the change in interview language options. The study protocol was  
20 reviewed and approved by the Institutional Review Boards of the University of Witwatersrand  
21 (M141103) in South Africa and Boston University (H-33516) in the USA.

## 22 23 **Results**

### 24 *Clinical and demographic characteristics at baseline*

25 Although 1167 (100% of target sample) HIV positive adults enrolled in the study, this analysis  
26 was limited to 1029 (88.2%) for whom an outcome could be ascertained (medical data was  
27 available), 146 (98.6%) pre-UTT, 141 (97.9%) under UTT, and 742 (94.5%) under the SDI  
28 policy (Figure 1). The survival analyses included only participants who were eligible for ART at  
29 the time of HIV diagnosis (n=1004). The exclusive use of English questionnaires in the pre-UTT  
30 cohort was the most significant reason for participant non-eligibility (25.9% of total screened).

1 However, the age and gender distributions were similar across cohorts (Median 32.6 years for  
2 Pre-UTT, interquartile range (IQR):27.2-37.6; 32.3 years for UTT, IQR: 27.2-38.9; and 32.3  
3 years for SDI, IQR: 28.4-39.5) (Table 2). Women (Median 32.6 years, IQR: 27.0-37.7) were  
4 slightly younger at HIV diagnosis than men (Median 35.8, IQR: 32.1-41.5) ( $\beta_{\text{female}}$  -3.4, 95%CI: -  
5 4.4 to -2.4). The pre-UTT cohort had a marginally higher proportion of participants who  
6 completed grade 12 (33.6%) compared to 28.6% in the UTT and 26.1% in the SDI cohorts.  
7 Employment rates were also similar across cohorts (47.9% pre-UTT, 46.8% UTT and 54.5%  
8 SDI). Among the 146 pre-UTT participants, 122 (83.6%) were eligible for ART.

9 Although the proportion of participants who tested with CD4 count<350/mm<sup>3</sup> decreased from  
10 65.8% pre-UTT to 39.7% in the same-day ART cohort, the percentage of patients with missing  
11 baseline CD4 count results increased from 3.4% to 34.7%, respectively. Among participant who  
12 had CD4 data, the proportion of patient with baseline CD4 count>500 cells/ $\mu$ l did not change  
13 substantially across guideline periods (20.0% during SDI vs 13.5% Pre-UTT, relative risk  
14 (RR)=1.5 (95%CI: 0.9-2.3) and RR=1.3 (95%CI: 0.9-2.4) for SDI vs UTT (18.1%)).

15 Although most participants lived within 15 minutes of the diagnosing clinic (56.9%), a small  
16 proportion reported travelling over 30 minutes to the clinic (12.5% overall, 6.8% pre-UTT, 4.3%  
17 under UTT and 15.2% under SDI policies). Travel time varied across clinics such that <12%  
18 participants from five of the six recruitment sites reported travelling over 30 minutes to the  
19 clinics, but 46.4% of participants from PHC four reported >30-minutes travel time.

20 *Time to ART initiation from HIV diagnosis across guideline periods*

1 Overall, 71.9% participants initiated ART within 30 days of HIV diagnosis, 36.5% pre-UTT  
2 (44.3% of those eligible for ART), 65.9% under UTT and 79.9% in the SDI period . The overall  
3 median days to ART initiation declined from 21 days (IQR: 15-30) to eight days (IQR: 6-16)  
4 after the implementation of the UTT policy. Time to ART start was further reduced to a median  
5 of five days (IQR: 0-8) after the SDI directive was given (Figure 2), with most reductions  
6 observed three months after the SDI policy directive was given to PHCs.

7 Overall, 30-day ART rates increased with increasing lag time from the prevailing (at the time of  
8 participant's HIV diagnosis) policy announcement (adjusted hazard ratio (aHR) 0.4 for  $\leq 3$ -  
9 months vs  $\geq 10$ -months, 95%CI: 0.3-0.6). The highest level of education was not associated with  
10 30-day ART uptake. After adjusting for the facility of diagnosis and lag time from the policy  
11 announcement, pre-UTT participants were 80% less likely to initiate ART in the first 30 days  
12 (aHR 0.2, 95% CI: 0.1-0.3) compared to SDI participants (Table 3). Similarly, patients  
13 diagnosed under the UTT policy were 70% less likely to start ART within 30 days of HIV  
14 diagnosis (aHR 0.3, 95% CI: 0.2-0.5) compared to SDI participants (Figure 3).

15 While women had higher 30-day ART rates compared to men (aHR 1.2, 95%CI: 1.0-1.4), there  
16 was no meaningful difference in the likelihood of 30-days ART initiation across age, marital  
17 status, travel time to the clinic or employment categories. Overall, compared to patients with  
18 baseline CD4<350 cell/ $\mu$ l, participants with baseline CD4>500 cells/ $\mu$ l had similar rates of 30-  
19 day ART. However, participants who were missing baseline CD4 counts were 40% less likely to  
20 start ART within a month (aHR 0.6, 95% CI: 0.5-0.7). Participants who lived in a two-adult  
21 home had higher rates of 30-day ART than those who lived alone (aHR 1.2, 95%CI: 1.0-1.5).  
22 Women were more likely to live with at least one other adult (RR 1.2, 95%CI: 1.1-1.4) compared  
23 to men.

#### 24 *Demographic and clinical characteristics associated with immediate ART initiation within the* 25 *SDI cohort*

26 Within the SDI cohort, 150 (20.2%) participants initiated treatment on the day of HIV diagnosis  
27 (25.3% of those who initiated ART within 30 days). Women were more likely to take up  
28 immediate ART (aRR 1.3, 95%CI: 1.0-1.9) than men. Older participants (aRR 0.6 for patients  
29  $\geq 40$  years old compared to patients in the 18-24 age group, 95% CI: 0.4-0.9) were less likely to  
30 start ART on the day of HIV diagnosis (Table 4). In the SDI period, missing baseline CD4 data



1 did not affect the likelihood of starting ART on the day of HIV diagnosis (aRR 1.5, 95%CI: 0.5-  
2 3.7). We also describe a high variability in SDI policy implementation across sites (Table 4).  
3 Figure four illustrates the rates of immediate ART by SDI policy-month with 95% confidence  
4 intervals for the proportions. However, immediate ART rates increased gradually with longer  
5 policy implementation time (aRR 0.2 for <3 months vs >10 months, 95%CI: 0.1-0.4) (Figure 4).  
6

## 7 **Discussion**

8 This study highlights a marked reduction in time to ART initiation following the implementation  
9 of the UTT guidelines, decreasing from a median of 21 days to eight days, despite this policy not  
10 including a directive to modify ART initiation times. An additional decline in time to ART start  
11 was also observed after the same-day ART memorandum was sent to clinics. These declines in  
12 time-to-ART are consistent with the goals of the WHO HIV treatment guidelines: to initiate  
13 patients as early as possible to achieve better clinical outcomes (15-16).

14 Consistent with previous findings (29), we found a decrease in the proportion of patients  
15 presenting at PHCs for HIV diagnosis with CD4 <350 cells/ $\mu$ l but little improvement in the  
16 CD4>500 cells/ $\mu$ l group between the pre-UTT and SDI periods. Overall, nearly two-thirds of  
17 participants who had baseline CD4 data were diagnosed with HIV with low CD4 counts (<350  
18 cell/ $\mu$ l).

19 Over a third of the SDI cohort was missing baseline CD4 data. Missing baseline CD4 data in the  
20 SDI cohort could have resulted from the lack of clarity in the policy with regards to the need or  
21 timing of safety blood tests early in the same-day ART policy implementation or patient  
22 impatience with the drawn-out HIV testing and ART initiation processes on the day of HIV  
23 testing (17, 25, 30). It is unclear whether this is a result of the change in the definition of entry in  
24 HIV care (first blood draw vs HIV diagnosis) for the SDI cohort. However, this increase in  
25 missing baseline CD4 was observed from the pre-UTT cohort to the UTT cohort, at which point  
26 clinics already began to reduce time to ART start (to the first week of care for some patients).  
27 Nevertheless, having a missing baseline CD4 was associated with a reduced likelihood of 30-day  
28 ART compared to patients with lower baseline CD4 values. When we restricted the analysis to  
29 the SDI cohort, having a missing CD4 count was associated with a non-significant increase in  
30 immediate ART rates, which possibly also means that patients diagnosed under the SDI policy

1 may start ART before the first blood draw and defer baseline CD4 tests. However, this finding  
2 requires further exploration.

3 Women were more likely to start ART within 30 days than men. Interestingly, participants who  
4 lived in a two-adult home rather than alone were more likely to initiate ART within 30 days. This  
5 may also be indirectly associated with gender as men were more likely to live alone than women.  
6 However, participants who lived in larger households had similar 30-day ART rates to those who  
7 lived alone, suggesting persisting fear of confidentiality breaches within homes (5, 9).

8 Only 20.2% of patients diagnosed under the SDI policy started ART on the day of diagnosis,  
9 highlighting possible facility-level policy assimilation challenges. Rates of immediate ART and  
10 30-days ART were also higher among non-pregnant women than men. Immediate ART has been  
11 available to South African HIV positive pregnant women since 2013 with relatively few patients  
12 or provider acceptability challenges (13, 31-33). However, health provider concerns about the  
13 SDI policy for the general population may have affected the pace of the policy implementation  
14 (25). In a previous qualitative study, Healthcare providers expressed reservations about the  
15 acceptability of immediate ART for the majority of their patients and the feasibility of the  
16 strategy considering their current workload (25). However, immediate ART rates steadily  
17 increased over time, suggesting improvements policy assimilation, albeit with some variability  
18 across sites. While CD4 count did not influence immediate ART uptake, women were younger at  
19 HIV diagnosis than men, highlighting the persisting need for consistent efforts to increase early  
20 HIV testing and ART initiation younger men (1, 31).

21 The strength of these analyses lies in the three prospective cohorts, spanning three ART  
22 guideline periods in South Africa, allowing direct observation of the changes in ART uptake  
23 over time. This study improves on a possible retrospective review by the collection of extensive  
24 personal and contextual data that are not routinely collected. However, the study data are limited  
25 by the small number of health facilities assessed, limited information about additional facility-  
26 level interventions as well as the contributions by partner organisations in supporting policy  
27 assimilation and implementation. Therefore, a more representative facility survey is needed to  
28 better explain the facility-level variations in ART policy implementation and outcomes.  
29 Additionally, we only collected ART initiation data from testing facilities with a short follow-up  
30 period and were not able to determine if some participants went on to start ART elsewhere.

1 Furthermore, the reason for the higher ART uptake among same-day ART participants require  
2 further exploration around the ART initiation processes and their potential impact on patients'  
3 future health-seeking behaviour as well as long term on-ART outcomes. The sample size did  
4 influence the duration of the enrolment process. However, the date of enrolment start depended  
5 on ethics approval. Unfortunately, we were negatively affected by university student protests that  
6 caused the Human Research Ethics department to stop operations for a while, resulting in a  
7 backlog of applications. To compensate for this, we adjusted all multivariate analyses by the lag  
8 period between the policy directive to the clinics and the date of patient's HIV diagnosis.

## 10 **Conclusion**

11 Our results highlight a positive move towards earlier ART initiation after the implementation of  
12 the UTT and SDI policies. However, the results also emphasise a vital need to not only  
13 streamline processes to increase immediate ART implementation/uptake further but also ensure  
14 timeous baseline safety and monitoring blood tests. Going forward, the need to improve patient  
15 demand for early HIV testing remains pertinent to achieve the prevention and treatment benefits  
16 of ART.

## 18 **Acknowledgements**

19 We extend our gratitude to the staff of PHC clinics who supported the implementation of the  
20 study and our sincere thanks go to the patients attending these clinics for their willingness to  
21 participate and share the valuable information that made this study possible.

## 22 **Author Contributions**

23 DO and MPF conceptualized the study and paper. TS managed the study implementation and  
24 conducted the primary data analysis. TS, CH, IM, implemented the study and contributed to the  
25 result interpretation. LL and MM contributed to the interpretation of the results. All authors  
26 reviewed and approved the manuscript.

## 1 **Conflict of Interest**

2 Authors have no conflicts of interest to declare.

## 4 **Funding**

5 This study has been made possible by the generous support of the American People and the  
6 President's Emergency Plan for AIDS Relief (PEPFAR) through United States Agency for  
7 International Development (USAID) under the terms of Cooperative Agreements AID-674-A-  
8 12-00029 and 72067419CA00004 to HE2RO. The contents are the responsibility of the authors  
9 and do not necessarily reflect the views of PEPFAR, USAID or the United States Government.

## 11 **Data Statement**

12 Patient medical records are owned by the study site and the National Department of Health  
13 (South Africa) and governed by the Human Research Ethics Committee (University of  
14 Witwatersrand, Johannesburg, South Africa). All relevant data is included in the paper.

## 16 **References**

- 18 1. HSRC. The Fifth South African National HIV Prevalence, Incidence, Behaviour and  
19 Communication Survey, 2017: HIV Impact Assessment Summary Report. Cape Town,  
20 HSRC Press.; 2017.
- 22 2. Boyer S, Iwuji C, Gosset A, Protopopescu C, Okesola N, Plazy M, et al. Factors  
23 associated with antiretroviral treatment initiation amongst HIV-positive individuals linked  
24 to care within a universal test and treat programme: early findings of the ANRS 12249  
25 TasP trial in rural South Africa. *AIDS Care*. 2016;28(sup3):39-51.
- 27 3. Collins S, Geffen N. Community views: balancing the public health benefits of earlier  
28 antiretroviral treatment with the implications for individual patients – perspectives from  
29 the community. *Current Opinion in HIV and AIDS*. 2014;9(1):4-10.

- 1  
2  
3 1 4. Cassim N, Coetzee LM, Schnippel K, Glencross DK. Estimating Implementation and  
4 2 Operational Costs of an Integrated Tiered CD4 Service including Laboratory and Point of  
5 3 Care Testing in a Remote Health District in South Africa. PLoS ONE.  
6 4 2014;9(12):e115420.  
7 5  
8 5
- 9  
10 6 5. Human Sciences Research Council (HSRC). The People Living With HIV Stigma Index:  
11 7 South Africa 2014. HSRC Press: 2014 Accessed October 2018  
12 8 [http://www.stigmaindex.org/sites/default/files/reports/Summary-Booklet-on-Stigma-  
13 9 Index-Survey%20South%20Africa.pdf](http://www.stigmaindex.org/sites/default/files/reports/Summary-Booklet-on-Stigma-Index-Survey%20South%20Africa.pdf)  
14 10
- 15  
16 11 6. [Goudge J, Ngoma B, Manderson L, Schneider H. Stigma, identity and resistance among  
17 12 people living with HIV in South Africa. SAHARA-J: Journal of Social Aspects of  
18 13 HIV/AIDS. 2009;6\(3\):94-104.](#)  
19 14
- 20  
21 15 7. Ahmed S, Autrey J, Katz IT, Fox MP, Rosen S, Onoya D, et al. Why do people living  
22 16 with HIV not initiate treatment? A systematic review of qualitative evidence from low-  
23 17 and middle-income countries. Social Science & Medicine. 2018;213:72-84.  
24 18
- 25  
26 19 8. [Abrahams N, Jewkes R. Managing and resisting stigma: a qualitative study among people  
27 20 living with HIV in South Africa. Journal of the International AIDS Society. 2012  
28 21 Apr;15\(2\):10-7448.](#)  
29 22
- 30  
31 23 9. Treves-Kagan S, Steward WT, Ntswane L, Haller R, Gilvydis JM, Gulati H, Barnhart S,  
32 24 Lippman SA. Why increasing availability of ART is not enough: a rapid, community-  
33 25 based study on how HIV-related stigma impacts engagement to care in rural South Africa.  
34 26 BMC public health. 2015 Dec;16(1):87.  
35 27
- 36  
37 28 10. South African National Department of Health (SA-NDoH). National Antiretroviral  
38 29 Treatment Guidelines, 2004. Pretoria: SA-NDoH;2004.  
39 30
- 40  
41 31 11. South African National Department of Health (SA-NDoH). National Antiretroviral  
42 32 Treatment Guidelines, 2010. Pretoria: SA-NDoH;2010.  
43 33
- 44  
45 34 12. South African National Department of Health (SA-NDoH). Circular on new criteria for  
46 35 initiating adults on ART at CD4 count of 350 cells/ml and below 2011. Pretoria: SA-  
47 36 NDoH; 2011.  
48 37
- 49  
50 38 13. South African National Department of Health (SA-NDoH). National Antiretroviral  
51 39 Treatment Guidelines 2013. Pretoria: SA NDoH;2013.  
52 40
- 53  
54 41 14. South African National Department of Health (SA-NDoH). National Consolidated  
55 42 Guidelines for the prevention of mother-to-child transmission of HIV (PMTCT) and the  
56 43 management of HIV in children, adolescents and adults 2015: SA NDoH;2015.  
57 44

- 1  
2  
3 1 15. Abuelezam N N, McCormick AW, Fussell T, Afriyie AN, Wood R, DeGruttola V, et al.  
4 2 Can the Heterosexual HIV Epidemic be Eliminated in South Africa Using Combination  
5 3 Prevention? A Modeling Analysis. *American journal of epidemiology*. 2016;184(3):239-  
6 4 48.  
7 5  
8 6  
9 6 16. Eaton JW, Johnson LF, Salomon JA, Bärnighausen T, Bendavid E, Bershteyn A, et al.  
10 7 HIV Treatment as Prevention: Systematic Comparison of Mathematical Models of the  
11 8 Potential Impact of Antiretroviral Therapy on HIV Incidence in South Africa. *PLOS*  
12 9 *Medicine*. 2012;9(7):e1001245.  
13 10  
14 11 17. South African National Department of Health (South Africa). Implementation of  
15 12 Universal Test and Treat Strategy for HIV positive patients and differentiated care for  
16 13 stable patients 2016. Pretoria: National Department of Health, 2016.  
17 14 <https://sahivsoc.org/Files/22%208%2016%20Circular%20UTT%20%20%20Decongestio>  
18 15 [n%20CCMT%20Directorate.pdf](https://sahivsoc.org/Files/22%208%2016%20Circular%20UTT%20%20%20Decongestio)  
19 16 Accessed October 2018  
20 17  
21 17 18. Group TAS, Danel C, Moh R, Gabillard D, Badje A, Le Carrou J, et al. A Trial of Early  
22 18 Antiretrovirals and Isoniazid Preventive Therapy in Africa. *The New England journal of*  
23 19 *medicine*. 2015;373(9):808-22.  
24 20  
25 21 19. Lundgren JD, Babiker AG, Gordin F, Emery S, Grund B, Sharma S, et al. Initiation of  
26 22 Antiretroviral Therapy in Early Asymptomatic HIV Infection. *N Engl J Med*.  
27 23 2015;373(9):795-807.  
28 24  
29 25 20. Rosen S, Maskew M, Fox MP, Nyoni C, Mongwenyana C, Maletse G. Initiating  
30 26 Antiretroviral Therapy for HIV at a Patient's First Clinic Visit: The RapIT Randomized  
31 27 Controlled Trial. 2016;13(5):e1002015.  
32 28  
33 29 21. INSIGHT START Study Group, Lundgren JD, Babiker AG, et al. Initiation of  
34 30 Antiretroviral Therapy in Early Asymptomatic HIV Infection. *New England Journal of*  
35 31 *Medicine*. 2015;373(9):795-807.  
36 32  
37 33 22. Cohen MS, Chen YQ, McCauley M, Gamble T, Hosseinipour MC, Kumarasamy N,  
38 34 Hakim JG, Kumwenda J, Grinsztejn B, Pilotto JH, Godbole SV. Prevention of HIV-1  
39 35 infection with early antiretroviral therapy. *New England journal of medicine*. 2011 Aug  
40 36 11;365(6):493-505.  
41 37  
42 38 23. Tanser F, Bärnighausen T, Grapsa E, Zaidi J, Newell ML. High coverage of ART  
43 39 associated with decline in risk of HIV acquisition in rural KwaZulu-Natal, South Africa.  
44 40 *Science*. 2013 Feb 22;339(6122):966-71..  
45 41  
46 42 24. South African National Department of Health (South Africa). Tracking implementation of  
47 43 the 90-90-90 strategy for HIV, through the implementation of Test and Treat (TT) policy

- 1  
2  
3 1 and same-day anti-retroviral therapy (ART) initiation for HIV positive patients 2017.  
4 2 Pretoria: National Department of Health; 2017.  
5 3  
6  
7 4  
8 25. Onoya D, Mokhele I, Sineke T, Ngoma B, Moolla A, Vujovic M, Bor J, Langa J, Fox M  
9 5 P. Health provider perspectives on implementation of same-day ART initiation six months  
10 6 after policy change in South Africa. International AIDS Conference (poster); 2018;  
11 7 Amsterdam.  
12 8  
13  
14 9  
15 26. Kulkarni SP, Shah KR, Sarma KV, Mahajan AP. Clinical Uncertainties, Health Service  
16 10 Challenges, and Ethical Complexities of HIV “Test-and-Treat”: A Systematic Review.  
17 11 American Journal of Public Health. 2013;103(6):e14-e23.  
18 12  
19 13  
20 27. Skhosana M, Reddy S, Reddy T, Ntoyanto S, Spooner E, Ramjee G, et al. PIMA TM  
21 14 point-of-care testing for CD4 counts in predicting antiretroviral initiation in HIV-infected  
22 15 individuals in KwaZulu-Natal, Durban, South Africa. Southern African Journal of HIV  
23 16 Medicine.2016;17(1).  
24 17  
25  
26 18  
27 28. Bigna JJR, Plottel CS, Koulla-Shiro S. Challenges in initiating antiretroviral therapy for  
28 19 all HIV-infected people regardless of CD4 cell count. Infectious Diseases of Poverty.  
29 20 2016;5(1):85.  
30 21  
31 22  
32 29. Siedner MJ, Ng CK, Bassett IV, Katz IT, Bangsberg DR, Tsai AC. Trends in CD4 count  
33 23 at presentation to care and treatment initiation in sub-Saharan Africa, 2002-2013: a meta-  
34 24 analysis. Clinical infectious diseases: an official publication of the Infectious Diseases  
35 25 Society of America. 2015;60(7):1120-7.  
36 26  
37  
38 27  
39 30. Egbujie BA, Grimwood A, Mothibi-Wabafor EC, Fatti G, Tshabalala AMET, Allie S, et  
40 28 al. Impact of ‘Ideal Clinic’ implementation on patient waiting time in primary healthcare  
41 29 clinics in KwaZulu-Natal Province, South Africa: A before-and-after evaluation. SAMJ  
42 30 Research. 2018;108(4):311-8.  
43 31  
44 32  
45 31. Langwenya N, Phillips TK, Brittain K, Zerbe A, Abrams EJ, Myer L. Same-day  
46 33 antiretroviral therapy (ART) initiation in pregnancy is not associated with viral  
47 34 suppression or engagement in care: A cohort study. Journal of the International AIDS  
48 35 Society. 2018;21(6):e25133.  
49 36  
50  
51 37  
52 38  
53 39  
54 40  
55  
56  
57  
58  
59  
60

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1 33. Black S, Zulliger R, Marcus R, Mark D, Myer L, Bekker L-G. Acceptability and  
2 challenges of rapid ART initiation among pregnant women in a pilot programme, Cape  
3 Town, South Africa. *AIDS Care*. 2014;26(6):736-41.

4 34.  
5

For peer review only



Table 1. Description of ART guideline changes over time in South Africa

| ART Guidelines  | Guideline eligibility/description                                                                                    | Introduction of guidelines/directive | Study recruitment period |
|-----------------|----------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------------------|
| Pre-UTT         | Eligible for ART start if CD4 <500 cells/ml                                                                          | January 2015                         | April-December 2015      |
| UTT, before SDI | Eligible for ART upon HIV-positive diagnosis, regardless of CD4 count                                                | September 2016                       | July-August 2017         |
| UTT + SDI       | Eligible for ART upon HIV-positive diagnosis, regardless of CD4 count. Initiate ART on day of HIV-positive diagnosis | September 2017                       | October 2017-August 2018 |

Table 2 Characteristics of the sample population by Period of HIV testing

|                                       | Pre-UTT<br>N=146 |                  | UTT<br>N=141 |                  | SDI<br>N=742 |                  | Total<br>N=1029 |                  |
|---------------------------------------|------------------|------------------|--------------|------------------|--------------|------------------|-----------------|------------------|
|                                       | n                | % (95%CI)        | n            | % (95%CI)        | n            | % (95%CI)        | n               | % (95%CI)        |
| <b>Facility</b>                       |                  |                  |              |                  |              |                  |                 |                  |
| PHC1                                  | 68               | 46.6 (38.6-54.8) | 72           | 51.1 (42.8-59.3) | 80           | 10.8 (8.7-13.2)  | 220             | 21.4 (18.9-23.9) |
| PHC2                                  | 78               | 53.4 (45.2-61.4) | 69           | 48.9 (40.7-57.2) | 51           | 6.9 (5.2-8.9)    | 198             | 19.2 (16.9-21.8) |
| PHC3                                  | -                | -                | -            | -                | 207          | 27.9 (24.8-31.2) | 207             | 20.1 (17.7-22.7) |
| PHC4                                  | -                | -                | -            | -                | 125          | 16.8 (14.3-19.7) | 125             | 12.1 (10.3-14.3) |
| PHC5                                  | -                | -                | -            | -                | 151          | 20.3 (17.6-23.4) | 151             | 14.6 (12.6-16.9) |
| PHC6                                  | -                | -                | -            | -                | 128          | 17.3 (14.7-20.1) | 128             | 12.4 (10.6-14.6) |
| <b>Time after policy announcement</b> |                  |                  |              |                  |              |                  |                 |                  |
| ≤3 months                             | 1                | 0.6 (0.09-4.8)   | 0            | 0                | 138          | 18.6 (15.9-21.6) | 139             | 13.5 (11.5-15.7) |
| 4-6 months                            | 40               | 27.4 (20.7-35.3) | 0            | 0                | 183          | 24.6 (21.7-27.9) | 223             | 21.6 (19.3-24.3) |
| 7-9 months                            | 72               | 49.3 (41.2-57.5) | 2            | 1.4 (0.3-5.6)    | 233          | 31.4 (28.2-34.8) | 307             | 29.8 (27.1-32.7) |
| ≥10 months                            | 33               | 22.6 (16.5-30.2) | 139          | 98.6 (94.4-99.7) | 188          | 25.3 (22.3-28.6) | 360             | 34.9 (32.1-37.9) |
| <b>Sex</b>                            |                  |                  |              |                  |              |                  |                 |                  |
| Female                                | 87               | 40.4 (32.7-48.7) | 81           | 42.6 (34.6-50.9) | 461          | 37.8 (34.4-41.4) | 629             | 38.9 (35.9-41.9) |
| Male                                  | 59               | 59.6 (51.3-67.3) | 60           | 57.4 (49.1-65.4) | 281          | 62.1 (58.6-65.6) | 400             | 61.1 (58.1-64.1) |
| <b>Age (median, IQR)</b>              |                  |                  |              |                  |              |                  |                 |                  |
| Median (IQR)                          |                  | 32.6 (27.2-37.6) |              | 32.8 (27.238.9)  |              | 33.3 (28.4-33.3) |                 | 33.2 (28.2-39.3) |
| 18 - 24                               | 20               | 13.7 (8.9-20.4)  | 20           | 14.2 (9.2-21.1)  | 82           | 10.9 (8.7-13.4)  | 122             | 11.8 (9.9-13.9)  |
| 25 - 29                               | 32               | 21.9 (15.9-29.4) | 33           | 23.4 (17.1-31.2) | 160          | 21.6 (18.7-24.7) | 225             | 21.9 (19.4-24.5) |
| 30 - 34                               | 41               | 28.1 (21.3-36.0) | 29           | 20.6 (14.6-28.1) | 177          | 23.9 (20.9-27.1) | 247             | 24.0 (21.5-26.7) |
| 35 - 39                               | 28               | 19.2 (13.5-26.5) | 31           | 21.9 (15.8-29.7) | 147          | 19.8 (17.1-22.8) | 206             | 20.0 (17.7-22.6) |
| 40+                                   | 25               | 17.1 (11.8-24.2) | 28           | 19.9 (14.0-27.4) | 176          | 23.8 (20.9-27.1) | 229             | 22.3 (19.9-25.0) |
| <b>Baseline CD4</b>                   |                  |                  |              |                  |              |                  |                 |                  |

|    |                                      |    |                  |    |                  |     |                  |     |                  |
|----|--------------------------------------|----|------------------|----|------------------|-----|------------------|-----|------------------|
| 1  |                                      |    |                  |    |                  |     |                  |     |                  |
| 2  |                                      |    |                  |    |                  |     |                  |     |                  |
| 3  | <350                                 | 96 | 65.7 (57.6-73.1) | 73 | 51.8 (43.5-59.9) | 296 | 39.9 (36.4-43.5) | 465 | 45.1 (42.2-48.2) |
| 4  | 350 - 500                            | 26 | 17.8 (12.4-24.9) | 22 | 15.6 (10.4-22.7) | 91  | 12.3 (10.1-14.8) | 139 | 13.5 (11.5-15.7) |
| 5  | ≥500                                 | 19 | 13.0 (8.4-19.6)  | 21 | 14.9 (9.8-21.9)  | 97  | 13.1 (10.8-15.7) | 137 | 13.3 (11.4-15.5) |
| 6  | Missing                              | 5  | 3.4 (1.4-8.0)    | 25 | 17.7 (12.2-25.0) | 258 | 34.8 (31.4-38.3) | 288 | 27.9 (25.3-30.8) |
| 7  |                                      |    |                  |    |                  |     |                  |     |                  |
| 8  | <b>Education</b>                     |    |                  |    |                  |     |                  |     |                  |
| 9  | < Grade 12                           | 97 | 66.4 (58.3-73.7) | 95 | 71.4 (63.1-78.5) | 544 | 73.9 (70.6-76.9) | 736 | 72.5 (69.7-75.2) |
| 10 | ≥ Grade 12                           | 49 | 33.5 (26.3-41.7) | 38 | 28.6 (21.5-36.9) | 192 | 26.1 (23.0-29.4) | 279 | 27.5 (24.8-30.3) |
| 11 |                                      |    |                  |    |                  |     |                  |     |                  |
| 12 | <b>Marital Status</b>                |    |                  |    |                  |     |                  |     |                  |
| 13 | Single                               | 28 | 19.2 (13.5-26.5) | 18 | 12.8 (8.1-19.4)  | 110 | 14.8 (12.5-17.6) | 156 | 15.1 (13.1-17.5) |
| 14 | In a relationship                    | 92 | 63.0 (54.8-70.5) | 98 | 69.5 (61.3-76.6) | 497 | 67.1 (63.6-70.4) | 687 | 66.8 (63.9-69.6) |
| 15 | Married                              | 21 | 14.4 (9.5-21.1)  | 18 | 12.8 (8.1-19.4)  | 112 | 15.1 (12.7-17.9) | 151 | 14.7 (12.7-16.9) |
| 16 | Divorced/widowed                     | 5  | 3.4 (1.4-8.0)    | 7  | 4.9 (2.4-10.1)   | 22  | 2.9 (1.9-4.5)    | 34  | 3.3 (2.3-4.5)    |
| 17 |                                      |    |                  |    |                  |     |                  |     |                  |
| 18 | <b>Employment Status</b>             |    |                  |    |                  |     |                  |     |                  |
| 19 | Unemployed                           | 70 | 25.0 (16.4-36.2) | 66 | 46.8 (38.6-55.2) | 402 | 54.5 (50.9-58.1) | 538 | 52.5 (49.5-55.6) |
| 20 | Employed                             | 76 | 75.0 (63.8-83.6) | 75 | 53.2 (44.8-61.4) | 335 | 45.5 (41.9-49.1) | 486 | 47.5 (44.4-50.5) |
| 21 |                                      |    |                  |    |                  |     |                  |     |                  |
| 22 | <b>Number of adults in household</b> |    |                  |    |                  |     |                  |     |                  |
| 23 | Lives alone                          | 28 | 19.2 (13.5-26.5) | 21 | 15.0 (9.9-22.0)  | 160 | 21.7 (18.9-24.9) | 209 | 20.4 (18.1-23.0) |
| 24 | Two adult in home                    | 82 | 56.2 (47.9-64.1) | 81 | 57.9 (49.4-65.8) | 429 | 58.3 (54.7-61.8) | 592 | 57.9 (54.9-60.9) |
| 25 | ≥ three adults                       | 36 | 24.7 (18.3-32.4) | 38 | 27.1 (20.4-35.2) | 147 | 19.9 (17.2-23.0) | 221 | 21.6 (19.2-24.3) |
| 26 |                                      |    |                  |    |                  |     |                  |     |                  |
| 27 | <b>Travel time to clinic</b>         |    |                  |    |                  |     |                  |     |                  |
| 28 | ≤15 minutes                          | 90 | 61.6 (53.4-69.3) | 90 | 63.8 (55.5-71.4) | 405 | 54.6 (50.9-58.1) | 585 | 56.8 (53.8-59.9) |
| 29 | 16-30 minutes                        | 46 | 31.5 (24.4-39.6) | 45 | 31.9 (24.7-40.1) | 224 | 30.2 (26.9-33.6) | 315 | 30.6 (27.9-33.5) |
| 30 | >30 minutes                          | 10 | 6.8 (3.6-12.3)   | 6  | 4.3 (1.9-9.2)    | 113 | 15.2 (12.8-18.0) | 129 | 12.5 (10.6-14.7) |

1

2 **Table 3 Demographic and clinical characteristics associated with initiating ART within 30 days of HIV**  
3 **diagnosis**

|    | 30-days ART n(%)                        | Person years | Incidence rates/100 PY (95% CI) | Crude HR (95% CI)   | Adjusted HR (95% CI) |               |
|----|-----------------------------------------|--------------|---------------------------------|---------------------|----------------------|---------------|
| 35 |                                         |              |                                 |                     |                      |               |
| 36 |                                         |              |                                 |                     |                      |               |
| 37 |                                         |              |                                 |                     |                      |               |
| 38 |                                         |              |                                 |                     |                      |               |
| 39 |                                         |              |                                 |                     |                      |               |
| 40 | <b>Facilities</b>                       |              |                                 |                     |                      |               |
| 41 | PHC 1                                   | 145 (70.0)   | 1.0                             | 146.9 (124.9-172.9) | 0.6 (0.5-0.8)        | 1.3 (0.8-2.0) |
| 42 | PHC 2                                   | 96 (51.3)    | 1.4                             | 70.8 (58.0-86.5)    | 0.3 (0.2-0.4)        | 0.7 (0.4-1.2) |
| 43 | PHC 3                                   | 169 (81.6)   | 0.7                             | 228.6 (196.6-265.8) | 0.9 (0.7-1.1)        | 0.8 (0.6-1.0) |
| 44 | PHC 4                                   | 98 (78.4)    | 0.4                             | 266.7 (218.8-325.1) | 1                    | 1             |
| 45 | PHC 5                                   | 121 (80.1)   | 0.6                             | 192.9 (161.4-230.5) | 0.7 (0.6-1.0)        | 0.7 (0.6-1.0) |
| 46 | PHC 6                                   | 111 (86.7)   | 0.4                             | 267.8 (222.3-322.5) | 1.0 (0.7-1.3)        | 0.9 (0.7-1.2) |
| 47 |                                         |              |                                 |                     |                      |               |
| 48 | <b>Guideline periods</b>                |              |                                 |                     |                      |               |
| 49 | Pre-UTT                                 | 54 (44.3)    | 1.0                             | 54.6 (41.8-71.3)    | 0.3 (0.2-0.4)        | 0.2 (0.1-0.3) |
| 50 | UTT                                     | 93 (66.0)    | 0.8                             | 117.8 (96.1-144.3)  | 0.6 (0.5-0.7)        | 0.3 (0.2-0.5) |
| 51 | Same-day ART                            | 593 (79.9)   | 2.7                             | 218.6 (201.7-236.9) | 1                    | 1             |
| 52 |                                         |              |                                 |                     |                      |               |
| 53 | <b>Months after policy announcement</b> |              |                                 |                     |                      |               |
| 54 | ≤3 months                               | 101 (73.2)   | 0.6                             | 159.9 (131.6-194.4) | 0.9 (0.7-1.1)        | 0.4 (0.3-0.6) |
| 55 | 4-6 months                              | 152 (69.7)   | 1.1                             | 138.2 (117.9-162.0) | 0.8 (0.7-1.0)        | 0.5 (0.4-0.7) |
| 56 | 7-9 months                              | 216 (74.0)   | 1.3                             | 170.2 (148.9-194.4) | 1.0 (0.8-1.1)        | 0.7 (0.6-0.9) |

20

|                              |            |     |                     |               |               |
|------------------------------|------------|-----|---------------------|---------------|---------------|
| ≥10 months                   | 271 (75.9) | 1.5 | 181.8 (161.4-204.8) | 1             | 1             |
| <b>Sex</b>                   |            |     |                     |               |               |
| Male                         | 266 (68.0) | 1.9 | 139.8 (123.9-157.6) | 1             | 1             |
| Female                       | 474 (77.2) | 2.6 | 183.1 (167.4-200.4) | 1.3 (1.1-1.5) | 1.2 (1.0-1.4) |
| <b>Age at testing</b>        |            |     |                     |               |               |
| 18 - 24                      | 87 (74.4)  | 0.5 | 180.4 (146.2-222.6) | 1             |               |
| 25 - 29                      | 159 (73.3) | 1.0 | 161.4 (138.2-188.6) | 0.9 (0.7-1.2) |               |
| 30 - 34                      | 170 (71.1) | 1.0 | 162.4 (139.8-188.8) | 0.9 (0.7-1.2) |               |
| 35 - 39                      | 146 (72.3) | 1.0 | 153.5 (130.5-180.5) | 0.9 (0.7-1.1) |               |
| 40+                          | 178 (77.4) | 1.0 | 173.4 (149.7-200.9) | 1.0 (0.7-1.2) |               |
| <b>Baseline CD4</b>          |            |     |                     |               |               |
| <350                         | 344 (74.0) | 2.2 | 154.4 (138.9-171.6) | 1             | 1             |
| 350 - 500                    | 103 (74.1) | 0.6 | 169.6 (139.8-205.7) | 1.1 (0.9-1.4) | 1.1 (0.8-1.3) |
| ≥500                         | 109 (92.4) | 0.4 | 310.4 (257.3-374.5) | 1.7 (1.3-2.1) | 1.2 (1.0-1.5) |
| Missing                      | 184 (65.0) | 1.3 | 141 (122.0-162.9)   | 1.0 (0.8-1.1) | 0.6 (0.5-0.7) |
| <b>Education</b>             |            |     |                     |               |               |
| < Grade 12                   | 527 (73.0) | 3.3 | 160.6 (147.4-174.9) | 1             |               |
| ≥ Grade 12                   | 203 (75.5) | 1.2 | 176.4 (153.7-202.4) | 1.1 (0.9-1.3) |               |
| <b>Marital Status</b>        |            |     |                     |               |               |
| Single                       | 114 (74.5) | 0.7 | 165.5 (137.8-198.9) | 1             |               |
| In a relationship            | 483 (72.2) | 3.0 | 163.7 (149.7-179.0) | 1.0 (0.8-1.2) |               |
| Married                      | 119 (79.9) | 0.7 | 175.9 (146.9-210.5) | 1.0 (0.8-1.4) |               |
| Divorced/widowed             | 23 (69.7)  | 0.2 | 132.4 (88.0-199.3)  | 0.8 (0.5-1.3) |               |
| <b>Employment Status</b>     |            |     |                     |               |               |
| Unemployed                   | 386 (73.4) | 2.4 | 163.5 (148.0-180.6) | 1             |               |
| Employed                     | 351 (74.1) | 2.1 | 167.1 (150.5-185.5) | 1.0 (0.9-1.2) |               |
| <b># adults in household</b> |            |     |                     |               |               |
| Lives alone                  | 141 (69.1) | 1.0 | 144 (122.1-169.9)   | 1             | 1             |
| Two adult in home            | 442 (76.5) | 2.5 | 178.6 (162.7-196.1) | 1.2 (1.0-1.4) | 1.2 (1.0-1.5) |
| ≥ three adults               | 153 (70.8) | 1.0 | 153.2 (130.7-179.5) | 1.0 (0.8-1.3) | 1.1 (0.9-1.5) |
| <b>Travel time to clinic</b> |            |     |                     |               |               |
| ≤15 minutes                  | 415 (73.2) | 2.6 | 161 (146.3-177.3)   | 1             | 1             |
| 16-30 minutes                | 218 (70.3) | 1.5 | 146.9 (128.7-167.8) | 0.9 (0.8-1.1) | 0.9 (0.8-1.1) |
| >30 minutes                  | 107 (83.6) | 0.4 | 248.6 (205.7-300.4) | 1.4 (1.1-1.8) | 1.1 (0.9-1.4) |

1  
2 **Table 4 Demographic and clinical characteristics associated with initiating ART on the day of HIV**  
3 **diagnosis**

|                 | Immediate ART<br>n(%) | Crude RR<br>(95% CI) | Adjusted<br>RR (95% CI) |
|-----------------|-----------------------|----------------------|-------------------------|
| <b>Facility</b> |                       |                      |                         |
| PHC 1           | 8 (10.0)              | 0.3 (0.2-0.6)        | 1.5 (0.5-4.3)           |

|    |                                         |            |               |               |
|----|-----------------------------------------|------------|---------------|---------------|
| 1  |                                         |            |               |               |
| 2  |                                         |            |               |               |
| 3  | PHC 2                                   | 9 (17.7)   | 0.5 (0.3-1.0) | 2.1 (0.9-4.9) |
| 4  | PHC 3                                   | 35 (16.9)  | 0.5 (0.3-0.7) | 0.7 (0.4-1.0) |
| 5  | PHC 4                                   | 42 (33.6)  | 1             | 1             |
| 6  | PHC 5                                   | 46 (30.5)  | 0.9 (0.6-1.3) | 1.3 (0.8-1.9) |
| 7  | PHC 6                                   | 10 (7.8)   | 0.2 (0.1-0.4) | 0.3 (0.1-0.5) |
| 8  |                                         |            |               |               |
| 9  |                                         |            |               |               |
| 10 | <b>Months after policy announcement</b> |            |               |               |
| 11 | ≤3 months                               | 15 (10.9)  | 0.3 (0.2-0.6) | 0.2 (0.1-0.4) |
| 12 | 4-6 months                              | 19 (10.4)  | 0.3 (0.2-0.5) | 0.3 (0.2-0.5) |
| 13 | 7-9 months                              | 57 (24.5)  | 0.8 (0.6-1.1) | 0.8 (0.6-1.0) |
| 14 | ≥10 months                              | 59 (31.4)  | 1             | 1             |
| 15 |                                         |            |               |               |
| 16 | <b>Sex</b>                              |            |               |               |
| 17 |                                         |            |               |               |
| 18 | Male                                    | 44 (15.7)  | 1             | 1             |
| 19 | Female                                  | 106 (23.0) | 1.5 (1.1-2.0) | 1.3 (1.0-1.9) |
| 20 |                                         |            |               |               |
| 21 | <b>Age at testing</b>                   |            |               |               |
| 22 | 18 - 24                                 | 25 (30.5)  | 1.0           | 1.0           |
| 23 | 25 - 29                                 | 37 (23.1)  | 0.8 (0.5-1.2) | 0.8 (0.5-1.3) |
| 24 | 30 - 34                                 | 38 (21.5)  | 0.7 (0.5-1.1) | 0.8 (0.5-1.2) |
| 25 | 35 - 39                                 | 24 (16.3)  | 0.5 (0.3-0.9) | 0.7 (0.4-1.1) |
| 26 | 40+                                     | 26 (14.8)  | 0.5 (0.3-0.8) | 0.6 (0.4-0.9) |
| 27 |                                         |            |               |               |
| 28 | <b>Baseline CD4</b>                     |            |               |               |
| 29 |                                         |            |               |               |
| 30 | <350                                    | 44 (14.9)  | 1.0           | 1.0           |
| 31 | 350 - 500                               | 18 (19.8)  | 1.3 (0.8-2.2) | 1.0 (0.4-2.6) |
| 32 | ≥500                                    | 20 (20.6)  | 1.4 (0.9-2.2) | 1.1 (0.4-2.9) |
| 33 | Missing                                 | 68 (26.4)  | 1.8 (1.3-2.5) | 1.5 (0.6-3.7) |
| 34 |                                         |            |               |               |
| 35 | <b>Education</b>                        |            |               |               |
| 36 | < Grade 12                              | 107 (19.7) | 1.0           |               |
| 37 | ≥ Grade 12                              | 43 (22.4)  | 1.1 (0.8-1.6) |               |
| 38 |                                         |            |               |               |
| 39 | <b>Marital Status</b>                   |            |               |               |
| 40 | Single                                  | 17 (15.5)  | 1.0           |               |
| 41 | In a relationship                       | 117 (23.5) | 1.5 (0.9-2.4) |               |
| 42 | Married                                 | 16 (14.3)  | 0.9 (0.5-1.7) |               |
| 43 | Divorced/widowed                        | 0          |               |               |
| 44 |                                         |            |               |               |
| 45 | <b>Employment Status</b>                |            |               |               |
| 46 | Unemployed                              | 76 (18.9)  | 1.0           |               |
| 47 | Employed                                | 72 (21.5)  | 1.1 (0.9-1.5) |               |
| 48 |                                         |            |               |               |
| 49 | <b># adults in household</b>            |            |               |               |
| 50 | Lives alone                             | 30 (18.7)  | 1.0           |               |
| 51 | Two adult in home                       | 88 (20.5)  | 1.1 (0.8-1.6) |               |
| 52 | ≥ three adults                          | 30 (20.4)  | 1.1 (0.7-1.7) |               |
| 53 |                                         |            |               |               |
| 54 | <b>Travel time to clinic</b>            |            |               |               |
| 55 | ≤15 minutes                             | 77 (19.0)  | 1.0           | 1.0           |
| 56 |                                         |            |               |               |
| 57 |                                         |            |               |               |
| 58 |                                         |            |               |               |
| 59 |                                         |            |               |               |
| 60 |                                         |            |               |               |

|               |           |               |               |
|---------------|-----------|---------------|---------------|
| 16-30 minutes | 41 (18.3) | 0.9 (0.7-1.4) | 1.1 (0.8-1.6) |
| >30 minutes   | 32 (28.3) | 1.5 (1.0-2.1) | 1.3 (0.8-2.0) |

**Figure 1. Participants flow from screening to ART initiation in the first 30 days of care by ART policy periods**

**Figure 2. Median time to ART start in the first 30 days of HIV care by ART policy periods**

**Figure 3. Kaplan Meier curve of ART initiation in the first 30 days of HIV care by ART policy periods**

**Figure 4. Immediate ART uptake in the first 12 months of the SDI policy implementation**

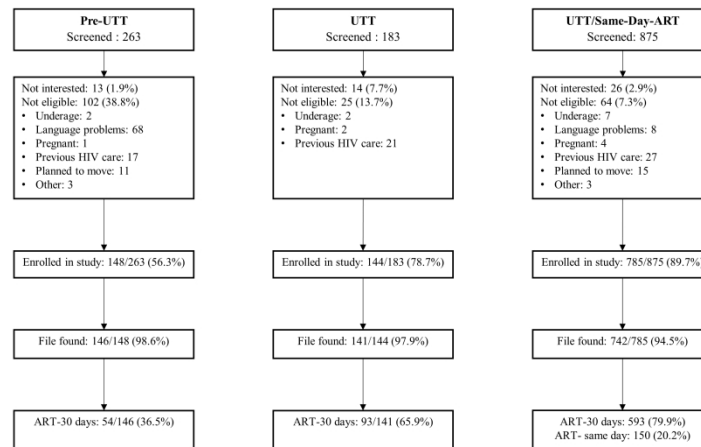
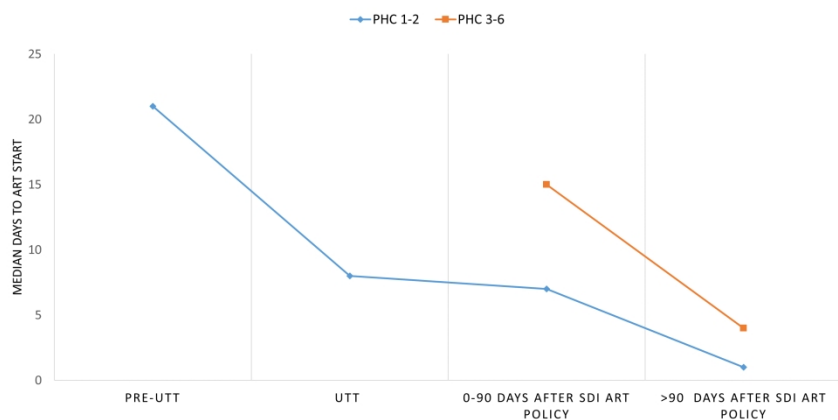
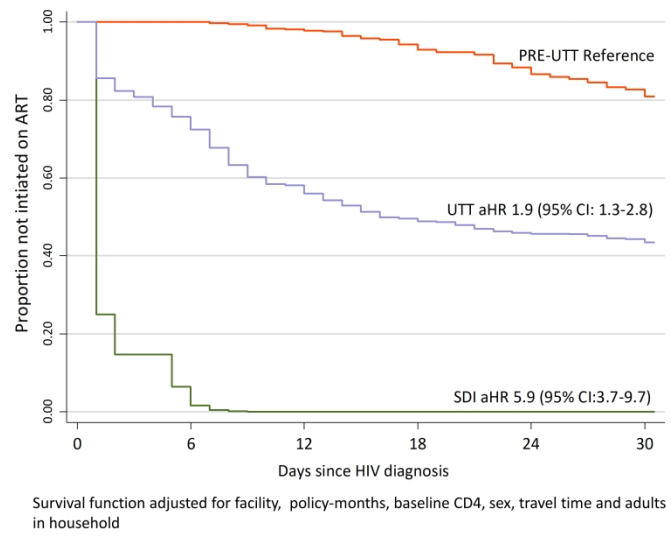


Figure 1. Participants flow from screening to ART initiation in the first 30 days of care by ART policy periods



Median time to ART start in the first 30 days of HIV care by ART policy periods

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



Kaplan Meier curve of ART initiation in the first 30 days of HIV care by ART policy periods



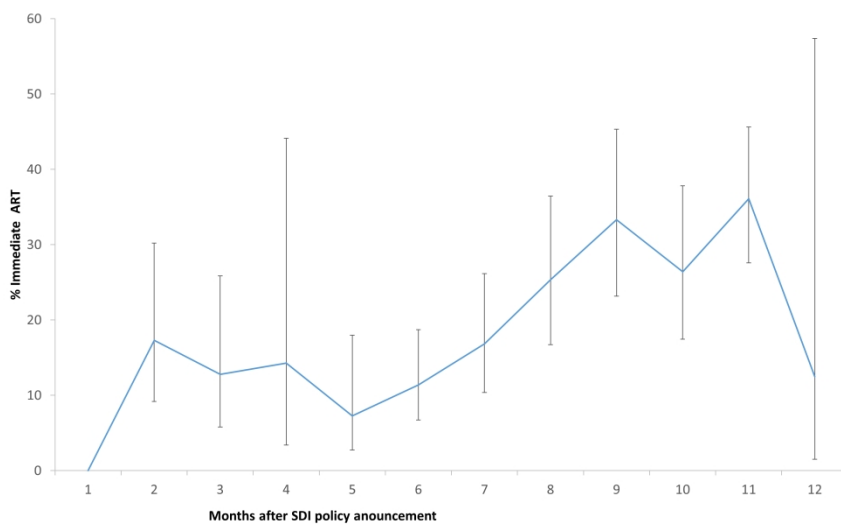


Figure 4. Immediate ART uptake in the first 12 months of the SDI policy implementation

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cohort studies**

| Section/Topic             | Item # | Recommendation                                                                                                                                                                       | Reported on page # |
|---------------------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| <b>Title and abstract</b> | 1      | (a) Indicate the study's design with a commonly used term in the title or the abstract                                                                                               | 2-3                |
|                           |        | (b) Provide in the abstract an informative and balanced summary of what was done and what was found                                                                                  |                    |
| <b>Introduction</b>       |        |                                                                                                                                                                                      |                    |
| Background/rationale      | 2      | Explain the scientific background and rationale for the investigation being reported                                                                                                 | 4-5                |
| Objectives                | 3      | State specific objectives, including any prespecified hypotheses                                                                                                                     | 5-6                |
| <b>Methods</b>            |        |                                                                                                                                                                                      |                    |
| Study design              | 4      | Present key elements of study design early in the paper                                                                                                                              | 5-6                |
| Setting                   | 5      | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection                                                      | 5-6                |
| Participants              | 6      | (a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up                                                           | 5-6                |
|                           |        | (b) For matched studies, give matching criteria and number of exposed and unexposed                                                                                                  |                    |
| Variables                 | 7      | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable                                             | 5-6                |
| Data sources/measurement  | 8*     | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 5-6                |
| Bias                      | 9      | Describe any efforts to address potential sources of bias                                                                                                                            | 6-7                |
| Study size                | 10     | Explain how the study size was arrived at                                                                                                                                            |                    |
| Quantitative variables    | 11     | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why                                                         | 6-7                |
| Statistical methods       | 12     | (a) Describe all statistical methods, including those used to control for confounding                                                                                                | 6-7                |
|                           |        | (b) Describe any methods used to examine subgroups and interactions                                                                                                                  | 6-7                |
|                           |        | (c) Explain how missing data were addressed                                                                                                                                          | 6-7                |
|                           |        | (d) If applicable, explain how loss to follow-up was addressed                                                                                                                       |                    |
|                           |        | (e) Describe any sensitivity analyses                                                                                                                                                |                    |
| <b>Results</b>            |        |                                                                                                                                                                                      |                    |

|                          |     |                                                                                                                                                                                                                                                                                                                                                                                                               |                           |
|--------------------------|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| Participants             | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed<br>(b) Give reasons for non-participation at each stage<br>(c) Consider use of a flow diagram                                                                                                               | 6<br>Figure 1<br>Figure 1 |
| Descriptive data         | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders<br>(b) Indicate number of participants with missing data for each variable of interest<br>(c) Summarise follow-up time (eg, average and total amount)                                                                                                                | 6<br>Table 2<br>5-6       |
| Outcome data             | 15* | Report numbers of outcome events or summary measures over time                                                                                                                                                                                                                                                                                                                                                | 6-7                       |
| Main results             | 16  | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included<br>(b) Report category boundaries when continuous variables were categorized<br>(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | <br>6-7, Table 2          |
| Other analyses           | 17  | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses                                                                                                                                                                                                                                                                                                                | Tables 2-4                |
| <b>Discussion</b>        |     |                                                                                                                                                                                                                                                                                                                                                                                                               |                           |
| Key results              | 18  | Summarise key results with reference to study objectives                                                                                                                                                                                                                                                                                                                                                      | 8-10                      |
| <b>Limitations</b>       |     |                                                                                                                                                                                                                                                                                                                                                                                                               |                           |
| Interpretation           | 20  | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence                                                                                                                                                                                                                                    | 10-12                     |
| Generalisability         | 21  | Discuss the generalisability (external validity) of the study results                                                                                                                                                                                                                                                                                                                                         | 10-12                     |
| <b>Other information</b> |     |                                                                                                                                                                                                                                                                                                                                                                                                               |                           |
| Funding                  | 22  | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based                                                                                                                                                                                                                                                 | 13                        |

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Impact of the test and treat policy on delays in antiretroviral therapy initiation among adult HIV positive patients from six clinics in Johannesburg, South Africa: results from a prospective cohort study

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Journal:                        | <i>BMJ Open</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Manuscript ID                   | bmjopen-2019-030228.R4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Article Type:                   | Original research                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Date Submitted by the Author:   | 26-Feb-2020                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Complete List of Authors:       | Onoya, Dorina; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office Sineke, Tembeka; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office Hendrickson, Cheryl; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office Mokhele, Idah; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office Maskew, Mhairi; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office Long, Lawrence; University of the Witwatersrand, School of Clinical Medicine, Health Economics & Epidemiology Research Office; Boston University, Boston School of Public Health, Department of Global Health Fox, Matthew; Boston University, Epidemiology and Global Health |
| <b>Primary Subject Heading</b>: | Health policy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Secondary Subject Heading:      | HIV/AIDS, Public health, Health policy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Keywords:                       | HIV & AIDS < INFECTIOUS DISEASES, Public health < INFECTIOUS DISEASES, PRIMARY CARE, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

SCHOLARONE™  
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

1  
2  
3  
4 **+Working Title:**

5  
6 2 Impact of the test and treat policy on delays in HIV treatment initiation in Johannesburg, South  
7  
8 3 Africa

9  
10 4 **Title: Impact of the test and treat policy on delays in antiretroviral therapy initiation among**  
11 **adult HIV positive patients from six clinics in Johannesburg, South Africa: results from a**  
12 **prospective cohort study**  
13  
14 6

15  
16 7 **Authors:** Dorina Onoya<sup>1</sup>, Tembeka Sineke<sup>1</sup>, Cheryl Hendrickson<sup>1</sup>, Idah Mokhele<sup>1</sup>, Mhairi  
17  
18 8 Maskew<sup>1</sup>, Lawrence Long<sup>1,2</sup>, Matthew P. Fox<sup>1,2,3</sup>

19  
20 9 <sup>1</sup> Health Economics and Epidemiology Research Office, Department of Internal Medicine, School  
21  
22 10 of Clinical Medicine, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg,  
23  
24 11 South Africa

25 12 <sup>2</sup> Department of Global Health, Boston University School of Public Health, Boston, MA, USA

26  
27 13 <sup>3</sup> Department of Epidemiology, Boston University School of Public Health, Boston, MA, USA  
28  
29 14

30 15 **Corresponding author:** Dorina Onoya, Health Economics and Epidemiology Research Office,  
31  
32 16 39 Empire Road, Parktown, Johannesburg, 2193, South Africa, [donoya@heroza.org](mailto:donoya@heroza.org) +27 10 001  
33  
34 17 7930

35  
36 18  
37 19 **Keywords:** HIV, ART attrition, UTT, same-day ART  
38  
39 20

40  
41 21 **Word count (main body):** 3436  
42  
43 22  
44  
45 23  
46  
47 24  
48  
49 25  
50  
51 26  
52  
53 27  
54  
55  
56  
57  
58  
59  
60

## 1 Abstract

2 **Objectives** To assess delays to antiretroviral therapy (ART) initiation before and after the  
3 Universal Test & Treat (UTT) and the same-day initiation (SDI) of ART policy periods in  
4 Johannesburg, South Africa.

5 **Design** Prospective cohort study

6 **Setting** Patients were recruited from six primary health clinics in Johannesburg.

7 **Participants** Overall, 1029 newly diagnosed HIV positive adults ( $\geq 18$  years) were consecutively  
8 enrolled by referral from the testing counsellor between April- December 2015 (Pre-UTT  
9  $n=146$ ), July-August 2017 (UTT,  $n=141$ ) and October 2017-August 2018 (SDI,  $n=742$ ).

10 **Main outcome measures** Cox proportional hazards regression was used to assess predictors of  
11 30-days ART initiation. Additionally, predictors of immediate ART initiation were evaluated  
12 using Poisson regression.

13 **Results** Overall, 30-days ART proportions were 71.9% overall, 36.9% pre-UTT (44.3% of those  
14 eligible), 65.9% under UTT and 79.9% under the SDI policy. The median days to ART initiation  
15 declined from 21 pre-UTT (Interquartile range (IQR): 15-30) to eight (IQR: 6-16) under UTT  
16 and five days (IQR: 0-8) under the SDI policy. However, only 150 (20.2%) of the SDI cohort  
17 initiated ART immediately after HIV diagnosis. Living in a two-adult home (adjusted Hazard  
18 ratio (aHR) 1.2 vs living alone, 95% Confidence Interval (CI): 1.0-1.5) increased the likelihood  
19 of 30-day ART. Missing baseline CD4 data decreased the likelihood of 30-days ART by 40%  
20 (aHR 0.6 vs CD4 $<350$  cell/ $\mu$ l, 95% CI: 0.5-0.7). More women took up immediate ART (adjusted  
21 relative risk (aRR) 1.3, 95%CI: 1.0-1.9). Participants  $\geq 40$  years (aRR 0.6 vs 18-24 years, 95%  
22 CI: 0.4-0.9) were less likely to start ART immediately after HIV diagnosis. However, immediate  
23 ART rates increased with longer policy implementation time (aRR 0.2 for  $<3$ -months vs  $>10$ -  
24 months, 95%CI: 0.1-0.4).

25 **Conclusions** The study results highlight a positive move towards earlier ART initiation during  
26 the UTT and SDI periods and emphasise a need to increase same-day ART implementation  
27 further.

28 **Word count: 300**

1  
2  
3 1  
4  
5  
6 2  
7  
8 3  
9 4  
10  
11  
12 5  
13 6  
14  
15  
16 7  
17 8  
18  
19 9  
20  
21 10  
22 11  
23  
24 12  
25 13  
26 14  
27 15  
28  
29 16  
30  
31 17  
32 18  
33  
34 19  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## Strengths and limitations

- Cohorts enrolled across the three most recent ART guideline implementation periods in South Africa, allowing observation of changes over time.
- Participants were enrolled immediately after HIV diagnosis, allowing for observation of ART initiation and patient attrition from HIV diagnosis over time.
- The results highlight a positive move towards earlier initiation of HIV treatment after the UTT policy implementation.
- Although we demonstrate substantial reductions in delays to ART initiation (median of 21 to five days), ART initiation on the day of HIV diagnosis is limited and requires additional investigations to improve programmatic performance.
- Increases in missing baseline laboratory tests at diagnosis reduce the strength of laboratory datasets as monitoring tools for the early steps of the HIV treatment cascade and delay the assessment of the appropriateness of the initial ART regimen.



## 1 Introduction

2 South Africa has the largest Human Immunodeficiency Virus (HIV) epidemic in the world, with  
3 an estimated 7.9 million persons living with HIV (1). Over the years, the South African  
4 government gradually increased the cluster of differentiation four (CD4)-based antiretroviral  
5 therapy (ART) eligibility threshold from 200 cells/ $\mu$ l in 2004, to 350 cells/ $\mu$ l in 2010 and 500  
6 cells/ $\mu$ l in January 2015 (2-6). These thresholds both capped the number of persons initiating  
7 ART and negatively affected the retention of pre-ART patients. In the past, attrition from care  
8 after HIV diagnosis was also related to the number of assessment and counselling visits required  
9 before treatment initiation for eligible patients and the lack of systematic monitoring of and  
10 benefits for patients who were not offered ART (2-7). Additional pre-ART determinants of  
11 losses from the HIV treatment cascade include gender, requirement for a treatment  
12 buddy/disclosure and HIV stigma, and the high cost of attending clinic visits (7-14).

13 In September 2016, South Africa removed the CD4 cell count threshold for ART eligibility and  
14 adopted the World Health Organization (WHO) 2015 Universal Test and Treat (UTT) policy,  
15 making all HIV positive patients eligible for ART at diagnosis (15-17). Clinical trials showed  
16 that, compared to patients who deferred ART, patients who started treatment immediately after  
17 HIV diagnosis had lower rates of acquired immunodeficiency syndrome (AIDS)-related adverse  
18 events and improved viral suppression rates with no difference in post-initiation attrition rates  
19 (18-22). Moreover, patients who started ART immediately after diagnosis were less likely to  
20 transmit HIV than patients who deferred ART (16, 21-23).

21 In September 2017, the general UTT policy was updated with a directive to initiate ART on the  
22 day of HIV diagnosis (same-day initiation - SDI) (24). While widespread support for the UTT  
23 policy has created momentum for its promulgation, there remained reservations from primary  
24 health care (PHC) providers that health system capacity constraints may limit same-day ART  
25 policy assimilation and result in variations in implementation at facility-level (25). The policy  
26 was implemented amid concerns that, under UTT, health facilities in high burden settings, in  
27 particular, might struggle with the increased patient burden, potentially reducing the quality of  
28 care provided to new and existing patients (2-4, 26-27). There were also concerns around patient  
29 acceptance of same-day ART, ART refusal or early patient disengagement from care or  
30 intermittent adherence after starting ART (28).

1 In 2017, an estimated 4.4 million (55.7%) South African HIV-positive patients had started ART  
2 (1). While this constituted a major increase in the number of HIV positive patients initiated on  
3 ART (nearly one million additional patients started ART between 2016 and 2017), the  
4 proportions also suggested continued challenges with patient linkage to ART after HIV diagnosis  
5 (1). Furthermore, in addition to measuring program success in terms of expanded access to ART,  
6 critical outcomes of the UTT policy include the initiation of patients with high CD4 (>500)  
7 count, reductions in delays to ART initiation and long-term retention in HIV care.

8 In this study, we set out to measure ART initiation of newly HIV diagnosed adults in the first 30  
9 days of HIV care (30-day ART) across the three recent ART guideline periods and examine  
10 factors associated with 30-days ART at six primary healthcare clinics (PHC) in Johannesburg,  
11 South Africa. Additionally, we examined rates and predictors of initiating ART on the day of  
12 HIV diagnosis among patients diagnosed under the SDI policy.

## 14 **Methods**

### 15 *Study Setting and design*

16 The city of Johannesburg is the largest of five health districts in the Gauteng province in South  
17 Africa. Johannesburg had an estimated HIV prevalence of 12.9% (>500,000 persons living with  
18 HIV) in 2017, with 60.7% of diagnosed persons currently receiving ART. Johannesburg  
19 comprises 108 PHCs subdivided into seven regions or sub-districts (denoted A-G) covering  
20 about 75% of the population (mainly uninsured). This study was conducted at six (of 13)  
21 conveniently selected public-sector PHCs in the Johannesburg health sub-district A. PHCs in  
22 Johannesburg are mainly nurse-run with the support of one medical doctor and are responsible  
23 for HIV testing, ART initiation and primary-level management and monitoring of HIV positive  
24 patients.

25 We conducted a prospective cohort study, enrolling consenting newly diagnosed HIV positive  
26 adult ( $\geq 18$  years) patients from April to December 2015 (CD4<500 or Pre-UTT period), July-  
27 August 2017 (UTT period) and October 2017-August 2018 (SDI period) (Summarised in Table  
28 1). Pre-UTT and UTT cohorts were only enrolled from two PHCs in Johannesburg while the SDI

1 cohort included four additional PHCs serving similar populations in the same area in  
2 Johannesburg (Table 2) (11-14).

3 Participant enrolment co-occurred across sites until 100% sample size was attained at each site  
4 (Figure 1). All patients were enrolled in the study after a new (self-reported) HIV-positive  
5 diagnosis (before ART eligibility determination) by trained study interviewers via referral from  
6 PHC-based lay HIV counsellors. We included newly diagnosed adult patients (18 years or older)  
7 who were able to speak English, Zulu and Sotho. Patients were eligible if they had entered HIV  
8 care after an HIV-positive diagnosis. Entering HIV care was defined as providing the first blood  
9 sample for baseline safety laboratory tests for the Pre-UTT and UTT cohorts, and defined as  
10 having received the HIV positive test result for the same-day ART cohort because new clinic  
11 processes meant that patients were likely to start ART before the first blood collection. The first  
12 blood tests were necessary to determine patients' CD4 count eligibility for ART and the  
13 appropriate initial ART regimen, hence the term "safety bloods". Women who were pregnant at  
14 HIV diagnosis were excluded from the study because ART initiation and monitoring processes in  
15 antenatal care differ from that of non-pregnant populations. Study staff cooperated closely with  
16 lay HIV counsellors across sites and checked HIV testing records daily to ensure that all testers  
17 who were diagnosed with HIV were being referred to study staff for study eligibility assessment.

### 18 *Study sample size*

19 We assumed that 70% of HIV positive patients with CD4 counts  $> 350$  cells/ $\mu$ l would become  
20 lost from HIV care in the first year after HIV diagnosis compared to 60% among patients with  
21 CD4  $\leq 350$  (29-30). We further hypothesised a 20% reduction in overall attrition between the  
22 pre-UTT and UTT periods. Additionally, the sample size for the SDI cohort was increased to  
23 enable a separate assessment of ART refusal (hypothesised 20% refusal by six-month post-HIV  
24 diagnosis) and attrition among participants who initiate ART with high CD4 count ( $>500$   
25 cells/ $\mu$ l)(31). The ART refusal analysis will be presented in future manuscripts. The number of  
26 sites was also increased to six to allow comparison of the same-day ART across clinics.

### 27 *Data Collection*

28 Patients provided written consent for all study procedures and completed an interviewer-  
29 administered baseline questionnaire after HIV testing, on the day of HIV diagnosis. Additionally,

1 participants were assured that participation in the study would in no way amend the care that  
2 they received at the clinic, including their future schedule of visits at the clinic. The consent  
3 process and interviews were conducted exclusively in English in the pre-UTT cohort because we  
4 assumed that the urban Johannesburg population would be conversant in English but later  
5 translated to Sotho and Zulu as well for the UTT and SDI cohorts. The interview included  
6 questions on demographic factors, socioeconomic status and health-seeking behaviour. The  
7 recency of the HIV diagnosis was determined from HIV testing history questions at baseline.  
8 Patients were passively followed up by paper and electronic (including laboratory data) medical  
9 record review up to 30 days after HIV diagnosis to determine ART initiation.

10 Person-time accrued from the date of HIV diagnosis (study enrolment) until ART initiation. We  
11 assumed that all patients for whom clinic files were created were in care for the first 30 days  
12 unless there was evidence of an official transfer or death in the first 30 days after HIV diagnosis.  
13 Trained data collectors captured routine clinical follow-up data of consenting participants from  
14 facility-based paper and electronic medical records, including laboratory test results from the  
15 National Health Laboratory Services (NHLS). We define baseline CD4 as the first CD4 results in  
16 up to 30 days after HIV diagnosis. Trained data collectors captured all routine clinical follow-up  
17 data on the REDCap (Research Electronic Data Capture) systems (Vanderbilt University,  
18 Nashville, Tennessee). All datasets were exported to STATA 14 (StataCorp, College Station,  
19 Texas) for the analysis.

#### 20 *Patient and Public Involvement*

21 Patients of the current study were not directly involved in the design of this study or reimbursed  
22 for their participation in the study. However, information collected from patients in previous  
23 studies informed the design, data collection approaches and interpretation of study results (19,  
24 24). Also, the study implementation was guided by health care workers from the participating  
25 study sites. Study participants consented to a once-off direct data collection after HIV diagnosis  
26 and passive follow-up data collection via medical record review. Therefore, direct result  
27 dissemination to patients will not be possible. However, we plan to present study results to health  
28 care workers and policy-makers at participating PHC clinics and at other policy-relevant forums.

#### 29 *Outcome data and analysis*

1 The primary exposure variable was the ART policy period at the time of HIV diagnosis,  
2 categorised as pre-UTT (policy active between January 2015 and August 2016), under the  
3 general UTT (active between September 2016 and August 2017) policy and the SDI policy  
4 (active from September 2017 onward) (14, 17, 24). The primary outcome was ART initiation up  
5 to 30 days after HIV diagnosis (30-day ART), and the secondary outcome is ART initiation  
6 immediately after HIV diagnosis (Immediate ART), both outcomes were coded Yes (1) or No  
7 (0). Final data analysis began in October 2018.

8 Continuous variables were described using medians and interquartile ranges. Categorical  
9 variables were described using percentages. Kaplan Meier analyses were conducted to assess  
10 time to ART initiation in the first 30 days of HIV care. Predictors of 30-day ART were modelled  
11 using Cox proportional hazards regression, reporting Hazard Ratios (HR). Variables with a p-  
12 value <0.1 in crude analyses were entered in the multivariate model. Schoenfeld residuals were  
13 used to test the assumption of proportional hazards. Interaction terms with time-varying  
14 covariates were created for variables that violated the proportional hazards assumption. Variables  
15 were excluded from the model when the inclusion of the interaction term did not resolve the  
16 proportional hazards assumption violation. Missing data, (where more than 5% of the data was  
17 missing) were accounted for by including a “not measured/missing” category where necessary.  
18 Additionally, predictors of ART initiation on the day of HIV diagnosis (dichotomised) were  
19 evaluated using Poisson Regression modelling, reporting Relative Risks (RR).

20 All multivariate analyses were adjusted for the time from the period-specific policy  
21 announcement to account for the varying lag periods between policy implementation and  
22 participant enrolment (policy-months at HIV diagnosis) across cohorts. Additionally, we tested  
23 the association between the highest level of education and ART initiation across guideline  
24 periods to account for the change in interview language options. The study protocol was  
25 reviewed and approved by the Institutional Review Boards of the University of Witwatersrand  
26 (M141103) in South Africa and Boston University (H-33516) in the USA.

## 28 **Results**

### 1 *Clinical and demographic characteristics at baseline*

2 Although 1167 (100% of target sample) HIV positive adults enrolled in the study, this analysis  
3 was limited to 1029 (88.2%) for whom an outcome could be ascertained (medical data was  
4 available), 146 (98.6%) pre-UTT, 141 (97.9%) under UTT, and 742 (94.5%) under the SDI  
5 policy (Figure 1). The survival analyses included only participants who were eligible for ART at  
6 the time of HIV diagnosis (n=1004). The exclusive use of English questionnaires in the pre-UTT  
7 cohort was the most significant reason for participant non-eligibility (25.9% of total screened).  
8 However, the age and gender distributions were similar across cohorts (Median 32.6 years for  
9 Pre-UTT, interquartile range (IQR):27.2-37.6; 32.3 years for UTT, IQR: 27.2-38.9; and 32.3  
10 years for SDI, IQR: 28.4-39.5) (Table 2). Women (Median 32.6 years, IQR: 27.0-37.7) were  
11 slightly younger at HIV diagnosis than men (Median 35.8, IQR: 32.1-41.5) ( $\beta_{\text{female}} -3.4$ , 95%CI: -  
12 4.4 to -2.4). The pre-UTT cohort had a marginally higher proportion of participants who  
13 completed grade 12 (33.6%) compared to 28.6% in the UTT and 26.1% in the SDI cohorts.  
14 Employment rates were also similar across cohorts (47.9% pre-UTT, 46.8% UTT and 54.5%  
15 SDI). Among the 146 pre-UTT participants, 122 (83.6%) were eligible for ART.

16 Although the proportion of participants who tested with CD4 count<350/mm<sup>3</sup> decreased from  
17 65.8% pre-UTT to 39.7% in the same-day ART cohort, the percentage of patients with missing  
18 baseline CD4 count results increased from 3.4% to 34.7%, respectively. Among participant who  
19 had CD4 data, the proportion of patient with baseline CD4 count>500 cells/ $\mu$ l did not change  
20 substantially across guideline periods (20.0% during SDI vs 13.5% Pre-UTT, relative risk  
21 (RR)=1.5 (95%CI: 0.9-2.3) and RR=1.3 (95%CI: 0.9-2.4) for SDI vs UTT (18.1%)).

22 Although most participants lived within 15 minutes of the diagnosing clinic (56.9%), a small  
23 proportion reported travelling over 30 minutes to the clinic (12.5% overall, 6.8% pre-UTT, 4.3%  
24 under UTT and 15.2% under SDI policies). Travel time varied across clinics such that <12%  
25 participants from five of the six recruitment sites reported travelling over 30 minutes to the  
26 clinics, but 46.4% of participants from PHC four reported >30-minutes travel time.

### 27 *Time to ART initiation from HIV diagnosis across guideline periods*

1 Overall, 71.9% participants initiated ART within 30 days of HIV diagnosis, 36.5% pre-UTT  
2 (44.3% of those eligible for ART), 65.9% under UTT and 79.9% in the SDI period. The overall  
3 median days to ART initiation declined from 21 days (IQR: 15-30) to eight days (IQR: 6-16)  
4 after the implementation of the UTT policy. Time to ART start was further reduced to a median  
5 of five days (IQR: 0-8) after the SDI directive was given (Figure 2), with most reductions  
6 observed three months after the SDI policy directive was given to PHCs.

7 Overall, 30-day ART rates increased with increasing lag time from the prevailing (at the time of  
8 participant's HIV diagnosis) policy announcement (adjusted hazard ratio (aHR) 0.4 for  $\leq 3$ -  
9 months vs  $\geq 10$ -months, 95%CI: 0.3-0.6). The highest level of education was not associated with  
10 30-day ART uptake. After adjusting for the facility of diagnosis and lag time from the policy  
11 announcement, pre-UTT participants were 80% less likely to initiate ART in the first 30 days  
12 (aHR 0.2, 95% CI: 0.1-0.3) compared to SDI participants (Table 3). Similarly, patients  
13 diagnosed under the UTT policy were 70% less likely to start ART within 30 days of HIV  
14 diagnosis (aHR 0.3, 95% CI: 0.2-0.5) compared to SDI participants (Figure 3).

15 While women had higher 30-day ART rates compared to men (aHR 1.2, 95%CI: 1.0-1.4), there  
16 was no meaningful difference in the likelihood of 30-days ART initiation across age, marital  
17 status, travel time to the clinic or employment categories. Overall, compared to patients with  
18 baseline CD4<350 cell/ $\mu$ l, participants with baseline CD4>500 cells/ $\mu$ l had similar rates of 30-  
19 day ART. However, participants who were missing baseline CD4 counts were 40% less likely to  
20 start ART within a month (aHR 0.6, 95% CI: 0.5-0.7). Participants who lived in a two-adult  
21 home had higher rates of 30-day ART than those who lived alone (aHR 1.2, 95%CI: 1.0-1.5).  
22 Women were more likely to live with at least one other adult (RR 1.2, 95%CI: 1.1-1.4) compared  
23 to men.

#### 24 *Demographic and clinical characteristics associated with immediate ART initiation within the* 25 *SDI cohort*

26 Within the SDI cohort, 150 (20.2%) participants initiated treatment on the day of HIV diagnosis  
27 (25.3% of those who initiated ART within 30 days). Women were more likely to take up  
28 immediate ART (aRR 1.3, 95%CI: 1.0-1.9) than men. Older participants (aRR 0.6 for patients  
29  $\geq 40$  years old compared to patients in the 18-24 age group, 95% CI: 0.4-0.9) were less likely to  
30 start ART on the day of HIV diagnosis (Table 4). In the SDI period, missing baseline CD4 data

1 did not affect the likelihood of starting ART on the day of HIV diagnosis (aRR 1.5, 95%CI: 0.5-  
2 3.7). We also describe a high variability in SDI policy implementation across sites (Table 4).  
3 Clinic four had the highest proportion of same-day ART initiates and was used as the reference  
4 category across all analyses. Figure four illustrates the rates of immediate ART by SDI policy-  
5 month with 95% confidence intervals for the proportions. However, immediate ART rates  
6 increased gradually with longer policy implementation time (aRR 0.2 for <3-months vs >10  
7 months, 95%CI: 0.1-0.4) (Figure 4).

## 8 9 **Discussion**

10 This study highlights a marked reduction in time to ART initiation following the implementation  
11 of the UTT guidelines, decreasing from a median of 21 days to eight days, despite this policy not  
12 including a directive to modify ART initiation times. An additional decline in time to ART start  
13 was also observed after the same-day ART memorandum was sent to clinics. These declines in  
14 time-to-ART are consistent with the goals of the WHO HIV treatment guidelines: to initiate  
15 patients as early as possible to achieve better clinical outcomes (15-16).

16 Consistent with previous findings (32), we found a decrease in the proportion of patients  
17 presenting at PHCs for HIV diagnosis with CD4 <350 cells/ $\mu$ l but little improvement in the  
18 CD4>500 cells/ $\mu$ l group between the pre-UTT and SDI periods. Overall, nearly two-thirds of  
19 participants who had baseline CD4 data were diagnosed with HIV with low CD4 counts (<350  
20 cell/ $\mu$ l).

21 Over a third of the SDI cohort was missing baseline CD4 data. Missing baseline CD4 data in the  
22 SDI cohort could have resulted from the lack of clarity in the policy with regards to the need or  
23 timing of safety blood tests early in the same-day ART policy implementation or patient  
24 impatience with the drawn-out HIV testing and ART initiation processes on the day of HIV  
25 testing (17, 25, 33). It is unclear whether this is a result of the change in the definition of entry in  
26 HIV care (first blood draw vs HIV diagnosis) for the SDI cohort. However, this increase in  
27 missing baseline CD4 was observed from the pre-UTT cohort to the UTT cohort, at which point  
28 clinics already began to reduce time to ART start (to the first week of care for some patients).  
29 Nevertheless, having a missing baseline CD4 was associated with a reduced likelihood of 30-day  
30 ART compared to patients with lower baseline CD4 values. When we restricted the analysis to



1 the SDI cohort, having a missing CD4 count was associated with a non-significant increase in  
2 immediate ART rates, which possibly also means that patients diagnosed under the SDI policy  
3 may start ART before the first blood draw and defer baseline CD4 tests. However, this finding  
4 requires further exploration.

5 Women were more likely to start ART within 30 days than men. Interestingly, participants who  
6 lived in a two-adult home rather than alone were more likely to initiate ART within 30 days. This  
7 may also be indirectly associated with gender as men were more likely to live alone than women.  
8 However, participants who lived in larger households had similar 30-day ART rates to those who  
9 lived alone, suggesting persisting fear of confidentiality breaches within homes (5, 9).

10 Only 20.2% of patients diagnosed under the SDI policy started ART on the day of diagnosis,  
11 highlighting possible facility-level policy assimilation challenges. Rates of immediate ART and  
12 30-days ART were also higher among non-pregnant women than men. Immediate ART has been  
13 available to South African HIV positive pregnant women since 2013 with relatively few patients  
14 or provider acceptability challenges (13, 34-36). However, health provider concerns about the  
15 SDI policy for the general population may have affected the pace of the policy implementation  
16 (25). In a previous qualitative study, Healthcare providers expressed reservations about the  
17 acceptability of immediate ART for the majority of their patients and the feasibility of the  
18 strategy considering their current workload (25). However, immediate ART rates steadily  
19 increased over time, suggesting improvements policy assimilation, albeit with some variability  
20 across sites. While CD4 count did not influence immediate ART uptake, women were younger at  
21 HIV diagnosis than men, highlighting the persisting need for consistent efforts to increase early  
22 HIV testing and ART initiation younger men (1, 34).

23 The strength of these analyses lies in the three prospective cohorts, spanning three ART  
24 guideline periods in South Africa, allowing direct observation of the changes in ART uptake  
25 over time. This study improves on a possible retrospective review by the collection of extensive  
26 personal and contextual data that are not routinely collected. However, the study data are limited  
27 by the small number of health facilities assessed, limited information about additional facility-  
28 level interventions as well as the contributions by partner organisations in supporting policy  
29 assimilation and implementation. Therefore, a more representative facility survey is needed to  
30 better explain the facility-level variations in ART policy implementation and outcomes.

1 Additionally, we only collected ART initiation data from testing facilities with a short follow-up  
2 period and were not able to determine if some participants went on to start ART elsewhere.

3 Furthermore, the reason for the higher ART uptake among same-day ART participants require  
4 further exploration around the ART initiation processes and their potential impact on 'patients'  
5 future health-seeking behaviour as well as long term on-ART outcomes. The sample size did  
6 influence the duration of the enrolment process. However, the date of enrolment start depended  
7 on ethics approval. Unfortunately, we were negatively affected by university student protests that  
8 caused the Human Research Ethics department to stop operations for a while, resulting in a  
9 backlog of applications. To compensate for this, we adjusted all multivariate analyses by the lag  
10 period between the policy directive to the clinics and the date of 'patient's HIV diagnosis.

## 11 12 **Conclusion**

13 Our results highlight a positive move towards earlier ART initiation after the implementation of  
14 the UTT and SDI policies. However, the results also emphasise a vital need to not only  
15 streamline processes to increase immediate ART implementation/uptake further but also ensure  
16 timeous baseline safety and monitoring blood tests. Going forward, the need to improve patient  
17 demand for early HIV testing remains pertinent to achieve the prevention and treatment benefits  
18 of ART.

## 19 20 **Acknowledgements**

21 We extend our gratitude to the staff of PHC clinics who supported the implementation of the  
22 study and our sincere thanks go to the patients attending these clinics for their willingness to  
23 participate and share the valuable information that made this study possible.

## 24 **Author Contributions**

25 DO and MPF conceptualised the study and paper. TS managed the study implementation and  
26 conducted the primary data analysis. TS, CH, IM, implemented the study and contributed to the  
27 result interpretation. LL and MM contributed to the interpretation of the results. All authors  
28 reviewed and approved the manuscript.

1

## 2 **Conflict of Interest**

3 Authors have no conflicts of interest to declare.

## 5 **Funding**

6 This study has been made possible by the generous support of the American People and the  
7 "President's Emergency Plan for AIDS Relief (PEPFAR) through United States Agency for  
8 International Development (USAID) under the terms of Cooperative Agreements AID-674-A-  
9 12-00029 and 72067419CA00004 to HE2RO. The contents are the responsibility of the authors  
10 and do not necessarily reflect the views of PEPFAR, USAID or the United States Government.

## 12 **Data Statement**

13 Patient medical records are owned by the study site and the National Department of Health  
14 (South Africa) and governed by the Human Research Ethics Committee (University of  
15 Witwatersrand, Johannesburg, South Africa). All relevant data is included in the paper.

## 17 **References**

- 19 1. HSRC. The Fifth South African National HIV Prevalence, Incidence, Behaviour and  
20 Communication Survey, 2017: HIV Impact Assessment Summary Report. Cape Town,  
21 HSRC Press.; 2017.
- 23 2. Boyer S, Iwuji C, Gosset A, Protopopescu C, Okesola N, Plazy M, et al. Factors  
24 associated with antiretroviral treatment initiation amongst HIV-positive individuals linked  
25 to care within a universal test and treat programme: early findings of the ANRS 12249  
26 TasP trial in rural South Africa. *AIDS Care*. 2016;28(sup3):39-51.
- 28 3. Collins S, Geffen N. Community views: balancing the public health benefits of earlier  
29 antiretroviral treatment with the implications for individual patients – perspectives from  
30 the community. *Current Opinion in HIV and AIDS*. 2014;9(1):4-10.

- 1  
2  
3 1 4. Cassim N, Coetzee LM, Schnippel K, Glencross DK. Estimating Implementation and  
4 2 Operational Costs of an Integrated Tiered CD4 Service including Laboratory and Point of  
5 3 Care Testing in a Remote Health District in South Africa. PLoS ONE.  
6 4 2014;9(12):e115420.  
7 5  
8 5
- 9  
10 6 5. Human Sciences Research Council (HSRC). The People Living With HIV Stigma Index:  
11 7 South Africa 2014. HSRC Press: 2014 Accessed October 2018  
12 8 [http://www.stigmaindex.org/sites/default/files/reports/Summary-Booklet-on-Stigma-  
13 9 Index-Survey%20South%20Africa.pdf](http://www.stigmaindex.org/sites/default/files/reports/Summary-Booklet-on-Stigma-Index-Survey%20South%20Africa.pdf)  
14 10
- 15  
16 11 6. [Goudge J, Ngoma B, Manderson L, Schneider H. Stigma, identity and resistance among  
17 12 people living with HIV in South Africa. SAHARA-J: Journal of Social Aspects of  
18 13 HIV/AIDS. 2009;6\(3\):94-104.](#)  
19 14
- 20  
21 15 7. Ahmed S, Autrey J, Katz IT, Fox MP, Rosen S, Onoya D, et al. Why do people living  
22 16 with HIV not initiate treatment? A systematic review of qualitative evidence from low-  
23 17 and middle-income countries. Social Science & Medicine. 2018;213:72-84.  
24 18
- 25  
26 19 8. [Abrahams N, Jewkes R. Managing and resisting stigma: a qualitative study among people  
27 20 living with HIV in South Africa. Journal of the International AIDS Society. 2012  
28 21 Apr;15\(2\):10-7448.](#)  
29 22
- 30  
31 23 9. Treves-Kagan S, Steward WT, Ntswane L, Haller R, Gilvydis JM, Gulati H, Barnhart S,  
32 24 Lippman SA. Why increasing availability of ART is not enough: a rapid, community-  
33 25 based study on how HIV-related stigma impacts engagement to care in rural South Africa.  
34 26 BMC public health. 2015 Dec;16(1):87.  
35 27
- 36  
37 28 10. South African National Department of Health (SA-NDoH). National Antiretroviral  
38 29 Treatment Guidelines, 2004. Pretoria: SA-NDoH;2004.  
39 30
- 40  
41 31 11. South African National Department of Health (SA-NDoH). National Antiretroviral  
42 32 Treatment Guidelines, 2010. Pretoria: SA-NDoH;2010.  
43 33
- 44  
45 34 12. South African National Department of Health (SA-NDoH). Circular on new criteria for  
46 35 initiating adults on ART at CD4 count of 350 cells/ml and below 2011. Pretoria: SA-  
47 36 NDoH; 2011.  
48 37
- 49  
50 38 13. South African National Department of Health (SA-NDoH). National Antiretroviral  
51 39 Treatment Guidelines 2013. Pretoria: SA NDoH;2013.  
52 40
- 53  
54 41 14. South African National Department of Health (SA-NDoH). National Consolidated  
55 42 Guidelines for the prevention of mother-to-child transmission of HIV (PMTCT) and the  
56 43 management of HIV in children, adolescents and adults 2015: SA NDoH;2015.  
57 44

- 1  
2  
3 1 15. Abuelezam N N, McCormick AW, Fussell T, Afriyie AN, Wood R, DeGruttola V, et al.  
4 2 Can the Heterosexual HIV Epidemic be Eliminated in South Africa Using Combination  
5 3 Prevention? A Modeling Analysis. *American journal of epidemiology*. 2016;184(3):239-  
6 4 48.  
7 5  
8 6  
9 6 16. Eaton JW, Johnson LF, Salomon JA, Bärnighausen T, Bendavid E, Bershteyn A, et al.  
10 7 HIV Treatment as Prevention: Systematic Comparison of Mathematical Models of the  
11 8 Potential Impact of Antiretroviral Therapy on HIV Incidence in South Africa. *PLOS*  
12 9 *Medicine*. 2012;9(7):e1001245.  
13 10  
14 11 17. South African National Department of Health (South Africa). Implementation of  
15 12 Universal Test and Treat Strategy for HIV positive patients and differentiated care for  
16 13 stable patients 2016. Pretoria: National Department of Health, 2016.  
17 14 <https://sahivsoc.org/Files/22%208%2016%20Circular%20UTT%20%20%20Decongestio>  
18 15 [n%20CCMT%20Directorate.pdf](https://sahivsoc.org/Files/22%208%2016%20Circular%20UTT%20%20%20Decongestio)  
19 16 Accessed October 2018  
20 17  
21 17 18. Group TAS, Danel C, Moh R, Gabillard D, Badje A, Le Carrou J, et al. A Trial of Early  
22 18 Antiretrovirals and Isoniazid Preventive Therapy in Africa. *The New England journal of*  
23 19 *medicine*. 2015;373(9):808-22.  
24 20  
25 21 19. Lundgren JD, Babiker AG, Gordin F, Emery S, Grund B, Sharma S, et al. Initiation of  
26 22 Antiretroviral Therapy in Early Asymptomatic HIV Infection. *N Engl J Med*.  
27 23 2015;373(9):795-807.  
28 24  
29 25 20. Rosen S, Maskew M, Fox MP, Nyoni C, Mongwenyana C, Maletse G. Initiating  
30 26 Antiretroviral Therapy for HIV at a Patient's First Clinic Visit: The RapIT Randomized  
31 27 Controlled Trial. 2016;13(5):e1002015.  
32 28  
33 29 21. INSIGHT START Study Group, Lundgren JD, Babiker AG, et al. Initiation of  
34 30 Antiretroviral Therapy in Early Asymptomatic HIV Infection. *New England Journal of*  
35 31 *Medicine*. 2015;373(9):795-807.  
36 32  
37 33 22. Cohen MS, Chen YQ, McCauley M, Gamble T, Hosseinipour MC, Kumarasamy N,  
38 34 Hakim JG, Kumwenda J, Grinsztejn B, Pilotto JH, Godbole SV. Prevention of HIV-1  
39 35 infection with early antiretroviral therapy. *New England journal of medicine*. 2011 Aug  
40 36 11;365(6):493-505.  
41 37  
42 38 23. Tanser F, Bärnighausen T, Grapsa E, Zaidi J, Newell ML. High coverage of ART  
43 39 associated with decline in risk of HIV acquisition in rural KwaZulu-Natal, South Africa.  
44 40 *Science*. 2013 Feb 22;339(6122):966-71..  
45 41  
46 42 24. South African National Department of Health (South Africa). Tracking implementation of  
47 43 the 90-90-90 strategy for HIV, through the implementation of Test and Treat (TT) policy

- 1  
2  
3 1 and same-day anti-retroviral therapy (ART) initiation for HIV positive patients 2017.  
4 2 Pretoria: National Department of Health; 2017.  
5 3  
6  
7 4  
8 25. Onoya D, Mokhele I, Sineke T, Ngoma B, Moolla A, Vujovic M, Bor J, Langa J, Fox M  
9 5 P. Health provider perspectives on implementation of same-day ART initiation six months  
10 6 after policy change in South Africa. International AIDS Conference (poster); 2018;  
11 7 Amsterdam.  
12 8  
13  
14 9  
15 26. Kulkarni SP, Shah KR, Sarma KV, Mahajan AP. Clinical Uncertainties, Health Service  
16 10 Challenges, and Ethical Complexities of HIV "Test-and-Treat": A Systematic Review.  
17 11 American Journal of Public Health. 2013;103(6):e14-e23.  
18 12  
19 13  
20 27. Skhosana M, Reddy S, Reddy T, Ntoyanto S, Spooner E, Ramjee G, et al. PIMA TM  
21 14 point-of-care testing for CD4 counts in predicting antiretroviral initiation in HIV-infected  
22 15 individuals in KwaZulu-Natal, Durban, South Africa. Southern African Journal of HIV  
23 16 Medicine.2016;17(1).  
24 17  
25  
26 18  
27 28. Bigna JJR, Plottel CS, Koulla-Shiro S. Challenges in initiating antiretroviral therapy for  
28 19 all HIV-infected people regardless of CD4 cell count. Infectious Diseases of Poverty.  
29 20 2016;5(1):85.  
30 21  
31 22  
32 29. Larson BA, Brennan A, McNamara L, Long L, Rosen S, Sanne I. Early loss to follow-up  
33 23 after enrolment in pre-ART care at a large public clinic in Johannesburg, South Africa.  
34 24 Tropical Medicine and International Health. 2010; 15(S1): 43-47.  
35 25  
36 26  
37 30. Lessells RJ, Mutevedzi PC, Cooke GS, Newell ML. Retention in HIV care for individuals  
38 27 not yet eligible for antiretroviral therapy: rural KwaZulu-Natal, South Africa. Journal of  
39 28 Acquired immune deficiency Syndrome. 2011; 56(3): e79-e86.  
40 29  
41 30  
42 31  
43 32  
44 33  
45 34  
46 35  
47 36  
48 37  
49 38  
50 39  
51 40  
52  
53 39  
54 40  
55  
56  
57  
58  
59  
60

1  
2  
3 1 clinics in KwaZulu-Natal Province, South Africa: A before-and-after evaluation. SAMJ  
4 2 Research. 2018;108(4):311-8.  
5 3  
6 4

7 4 34. Langwenya N, Phillips TK, Brittain K, Zerbe A, Abrams EJ, Myer L. Same-day  
8 5 antiretroviral therapy (ART) initiation in pregnancy is not associated with viral  
9 6 suppression or engagement in care: A cohort study. Journal of the International AIDS  
10 7 Society. 2018;21(6):e25133.  
11 8  
12 9

13 9 35. Garrett N, Norman E, Leask K, Naicker N, Asari V, Majola N, et al. Acceptability of  
14 10 Early Antiretroviral Therapy Among South African Women. AIDS Behav.  
15 11 2018;22(3):1018-24.  
16 12  
17 13

18 13 36. Black S, Zulliger R, Marcus R, Mark D, Myer L, Bekker L-G. Acceptability and  
19 14 challenges of rapid ART initiation among pregnant women in a pilot programme, Cape  
20 15 Town, South Africa. AIDS Care. 2014;26(6):736-41.  
21 16  
22 17  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

Table 1. Description of ART guideline changes over time in South Africa

| ART Guidelines  | Guideline eligibility/description                                                                                    | Introduction of guidelines/directive | Study recruitment period |
|-----------------|----------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------------------|
| Pre-UTT         | Eligible for ART start if CD4 <500 cells/ml                                                                          | January 2015                         | April-December 2015      |
| UTT, before SDI | Eligible for ART upon HIV-positive diagnosis, regardless of CD4 count                                                | September 2016                       | July-August 2017         |
| UTT + SDI       | Eligible for ART upon HIV-positive diagnosis, regardless of CD4 count. Initiate ART on day of HIV-positive diagnosis | September 2017                       | October 2017-August 2018 |

Table 2 Characteristics of the sample population by Period of HIV testing

|                                       | Pre-UTT<br>N=146 |                  | UTT<br>N=141 |                  | SDI<br>N=742 |                  | Total<br>N=1029 |                  |
|---------------------------------------|------------------|------------------|--------------|------------------|--------------|------------------|-----------------|------------------|
|                                       | n                | % (95%CI)        | n            | % (95%CI)        | n            | % (95%CI)        | n               | % (95%CI)        |
| <b>Facility</b>                       |                  |                  |              |                  |              |                  |                 |                  |
| PHC1                                  | 68               | 46.6 (38.6-54.8) | 72           | 51.1 (42.8-59.3) | 80           | 10.8 (8.7-13.2)  | 220             | 21.4 (18.9-23.9) |
| PHC2                                  | 78               | 53.4 (45.2-61.4) | 69           | 48.9 (40.7-57.2) | 51           | 6.9 (5.2-8.9)    | 198             | 19.2 (16.9-21.8) |
| PHC3                                  | -                | -                | -            | -                | 207          | 27.9 (24.8-31.2) | 207             | 20.1 (17.7-22.7) |
| PHC4                                  | -                | -                | -            | -                | 125          | 16.8 (14.3-19.7) | 125             | 12.1 (10.3-14.3) |
| PHC5                                  | -                | -                | -            | -                | 151          | 20.3 (17.6-23.4) | 151             | 14.6 (12.6-16.9) |
| PHC6                                  | -                | -                | -            | -                | 128          | 17.3 (14.7-20.1) | 128             | 12.4 (10.6-14.6) |
| <b>Time after policy announcement</b> |                  |                  |              |                  |              |                  |                 |                  |
| ≤3 months                             | 1                | 0.6 (0.09-4.8)   | 0            | 0                | 138          | 18.6 (15.9-21.6) | 139             | 13.5 (11.5-15.7) |
| 4-6 months                            | 40               | 27.4 (20.7-35.3) | 0            | 0                | 183          | 24.6 (21.7-27.9) | 223             | 21.6 (19.3-24.3) |
| 7-9 months                            | 72               | 49.3 (41.2-57.5) | 2            | 1.4 (0.3-5.6)    | 233          | 31.4 (28.2-34.8) | 307             | 29.8 (27.1-32.7) |
| ≥10 months                            | 33               | 22.6 (16.5-30.2) | 139          | 98.6 (94.4-99.7) | 188          | 25.3 (22.3-28.6) | 360             | 34.9 (32.1-37.9) |
| <b>Sex</b>                            |                  |                  |              |                  |              |                  |                 |                  |
| Female                                | 87               | 40.4 (32.7-48.7) | 81           | 42.6 (34.6-50.9) | 461          | 37.8 (34.4-41.4) | 629             | 38.9 (35.9-41.9) |
| Male                                  | 59               | 59.6 (51.3-67.3) | 60           | 57.4 (49.1-65.4) | 281          | 62.1 (58.6-65.6) | 400             | 61.1 (58.1-64.1) |
| <b>Age (median, IQR)</b>              |                  |                  |              |                  |              |                  |                 |                  |
| Median (IQR)                          |                  | 32.6 (27.2-37.6) |              | 32.8 (27.238.9)  |              | 33.3 (28.4-33.3) |                 | 33.2 (28.2-39.3) |
| 18 - 24                               | 20               | 13.7 (8.9-20.4)  | 20           | 14.2 (9.2-21.1)  | 82           | 10.9 (8.7-13.4)  | 122             | 11.8 (9.9-13.9)  |
| 25 - 29                               | 32               | 21.9 (15.9-29.4) | 33           | 23.4 (17.1-31.2) | 160          | 21.6 (18.7-24.7) | 225             | 21.9 (19.4-24.5) |
| 30 - 34                               | 41               | 28.1 (21.3-36.0) | 29           | 20.6 (14.6-28.1) | 177          | 23.9 (20.9-27.1) | 247             | 24.0 (21.5-26.7) |
| 35 - 39                               | 28               | 19.2 (13.5-26.5) | 31           | 21.9 (15.8-29.7) | 147          | 19.8 (17.1-22.8) | 206             | 20.0 (17.7-22.6) |
| 40+                                   | 25               | 17.1 (11.8-24.2) | 28           | 19.9 (14.0-27.4) | 176          | 23.8 (20.9-27.1) | 229             | 22.3 (19.9-25.0) |
| <b>Baseline CD4</b>                   |                  |                  |              |                  |              |                  |                 |                  |



|    |                                      |    |                  |    |                  |     |                  |     |                  |
|----|--------------------------------------|----|------------------|----|------------------|-----|------------------|-----|------------------|
| 1  |                                      |    |                  |    |                  |     |                  |     |                  |
| 2  |                                      |    |                  |    |                  |     |                  |     |                  |
| 3  | <350                                 | 96 | 65.7 (57.6-73.1) | 73 | 51.8 (43.5-59.9) | 296 | 39.9 (36.4-43.5) | 465 | 45.1 (42.2-48.2) |
| 4  | 350 - 500                            | 26 | 17.8 (12.4-24.9) | 22 | 15.6 (10.4-22.7) | 91  | 12.3 (10.1-14.8) | 139 | 13.5 (11.5-15.7) |
| 5  | ≥500                                 | 19 | 13.0 (8.4-19.6)  | 21 | 14.9 (9.8-21.9)  | 97  | 13.1 (10.8-15.7) | 137 | 13.3 (11.4-15.5) |
| 6  | Missing                              | 5  | 3.4 (1.4-8.0)    | 25 | 17.7 (12.2-25.0) | 258 | 34.8 (31.4-38.3) | 288 | 27.9 (25.3-30.8) |
| 7  |                                      |    |                  |    |                  |     |                  |     |                  |
| 8  | <b>Education</b>                     |    |                  |    |                  |     |                  |     |                  |
| 9  | < Grade 12                           | 97 | 66.4 (58.3-73.7) | 95 | 71.4 (63.1-78.5) | 544 | 73.9 (70.6-76.9) | 736 | 72.5 (69.7-75.2) |
| 10 | ≥ Grade 12                           | 49 | 33.5 (26.3-41.7) | 38 | 28.6 (21.5-36.9) | 192 | 26.1 (23.0-29.4) | 279 | 27.5 (24.8-30.3) |
| 11 |                                      |    |                  |    |                  |     |                  |     |                  |
| 12 | <b>Marital Status</b>                |    |                  |    |                  |     |                  |     |                  |
| 13 | Single                               | 28 | 19.2 (13.5-26.5) | 18 | 12.8 (8.1-19.4)  | 110 | 14.8 (12.5-17.6) | 156 | 15.1 (13.1-17.5) |
| 14 | In a relationship                    | 92 | 63.0 (54.8-70.5) | 98 | 69.5 (61.3-76.6) | 497 | 67.1 (63.6-70.4) | 687 | 66.8 (63.9-69.6) |
| 15 | Married                              | 21 | 14.4 (9.5-21.1)  | 18 | 12.8 (8.1-19.4)  | 112 | 15.1 (12.7-17.9) | 151 | 14.7 (12.7-16.9) |
| 16 | Divorced/widowed                     | 5  | 3.4 (1.4-8.0)    | 7  | 4.9 (2.4-10.1)   | 22  | 2.9 (1.9-4.5)    | 34  | 3.3 (2.3-4.5)    |
| 17 |                                      |    |                  |    |                  |     |                  |     |                  |
| 18 | <b>Employment Status</b>             |    |                  |    |                  |     |                  |     |                  |
| 19 | Unemployed                           | 70 | 25.0 (16.4-36.2) | 66 | 46.8 (38.6-55.2) | 402 | 54.5 (50.9-58.1) | 538 | 52.5 (49.5-55.6) |
| 20 | Employed                             | 76 | 75.0 (63.8-83.6) | 75 | 53.2 (44.8-61.4) | 335 | 45.5 (41.9-49.1) | 486 | 47.5 (44.4-50.5) |
| 21 |                                      |    |                  |    |                  |     |                  |     |                  |
| 22 | <b>Number of adults in household</b> |    |                  |    |                  |     |                  |     |                  |
| 23 | Lives alone                          | 28 | 19.2 (13.5-26.5) | 21 | 15.0 (9.9-22.0)  | 160 | 21.7 (18.9-24.9) | 209 | 20.4 (18.1-23.0) |
| 24 | Two adult in home                    | 82 | 56.2 (47.9-64.1) | 81 | 57.9 (49.4-65.8) | 429 | 58.3 (54.7-61.8) | 592 | 57.9 (54.9-60.9) |
| 25 | ≥ three adults                       | 36 | 24.7 (18.3-32.4) | 38 | 27.1 (20.4-35.2) | 147 | 19.9 (17.2-23.0) | 221 | 21.6 (19.2-24.3) |
| 26 |                                      |    |                  |    |                  |     |                  |     |                  |
| 27 | <b>Travel time to clinic</b>         |    |                  |    |                  |     |                  |     |                  |
| 28 | ≤15 minutes                          | 90 | 61.6 (53.4-69.3) | 90 | 63.8 (55.5-71.4) | 405 | 54.6 (50.9-58.1) | 585 | 56.8 (53.8-59.9) |
| 29 | 16-30 minutes                        | 46 | 31.5 (24.4-39.6) | 45 | 31.9 (24.7-40.1) | 224 | 30.2 (26.9-33.6) | 315 | 30.6 (27.9-33.5) |
| 30 | >30 minutes                          | 10 | 6.8 (3.6-12.3)   | 6  | 4.3 (1.9-9.2)    | 113 | 15.2 (12.8-18.0) | 129 | 12.5 (10.6-14.7) |

1

2 **Table 3 Demographic and clinical characteristics associated with initiating ART within 30 days of HIV**  
3 **diagnosis**

|    | 30-days ART n(%)                        | Person years | Incidence rates/100 PY (95% CI) | Crude HR (95% CI)   | Adjusted HR (95% CI) |               |
|----|-----------------------------------------|--------------|---------------------------------|---------------------|----------------------|---------------|
| 35 |                                         |              |                                 |                     |                      |               |
| 36 |                                         |              |                                 |                     |                      |               |
| 37 |                                         |              |                                 |                     |                      |               |
| 38 |                                         |              |                                 |                     |                      |               |
| 39 |                                         |              |                                 |                     |                      |               |
| 40 | <b>Facilities</b>                       |              |                                 |                     |                      |               |
| 41 | PHC 1                                   | 145 (70.0)   | 1.0                             | 146.9 (124.9-172.9) | 0.6 (0.5-0.8)        | 1.3 (0.8-2.0) |
| 42 | PHC 2                                   | 96 (51.3)    | 1.4                             | 70.8 (58.0-86.5)    | 0.3 (0.2-0.4)        | 0.7 (0.4-1.2) |
| 43 | PHC 3                                   | 169 (81.6)   | 0.7                             | 228.6 (196.6-265.8) | 0.9 (0.7-1.1)        | 0.8 (0.6-1.0) |
| 44 | PHC 4                                   | 98 (78.4)    | 0.4                             | 266.7 (218.8-325.1) | 1                    | 1             |
| 45 | PHC 5                                   | 121 (80.1)   | 0.6                             | 192.9 (161.4-230.5) | 0.7 (0.6-1.0)        | 0.7 (0.6-1.0) |
| 46 | PHC 6                                   | 111 (86.7)   | 0.4                             | 267.8 (222.3-322.5) | 1.0 (0.7-1.3)        | 0.9 (0.7-1.2) |
| 47 |                                         |              |                                 |                     |                      |               |
| 48 | <b>Guideline periods</b>                |              |                                 |                     |                      |               |
| 49 | Pre-UTT                                 | 54 (44.3)    | 1.0                             | 54.6 (41.8-71.3)    | 0.3 (0.2-0.4)        | 0.2 (0.1-0.3) |
| 50 | UTT                                     | 93 (66.0)    | 0.8                             | 117.8 (96.1-144.3)  | 0.6 (0.5-0.7)        | 0.3 (0.2-0.5) |
| 51 | Same-day ART                            | 593 (79.9)   | 2.7                             | 218.6 (201.7-236.9) | 1                    | 1             |
| 52 |                                         |              |                                 |                     |                      |               |
| 53 | <b>Months after policy announcement</b> |              |                                 |                     |                      |               |
| 54 | ≤3 months                               | 101 (73.2)   | 0.6                             | 159.9 (131.6-194.4) | 0.9 (0.7-1.1)        | 0.4 (0.3-0.6) |
| 55 | 4-6 months                              | 152 (69.7)   | 1.1                             | 138.2 (117.9-162.0) | 0.8 (0.7-1.0)        | 0.5 (0.4-0.7) |
| 56 | 7-9 months                              | 216 (74.0)   | 1.3                             | 170.2 (148.9-194.4) | 1.0 (0.8-1.1)        | 0.7 (0.6-0.9) |

20

|                              |            |     |                     |               |               |
|------------------------------|------------|-----|---------------------|---------------|---------------|
| ≥10 months                   | 271 (75.9) | 1.5 | 181.8 (161.4-204.8) | 1             | 1             |
| <b>Sex</b>                   |            |     |                     |               |               |
| Male                         | 266 (68.0) | 1.9 | 139.8 (123.9-157.6) | 1             | 1             |
| Female                       | 474 (77.2) | 2.6 | 183.1 (167.4-200.4) | 1.3 (1.1-1.5) | 1.2 (1.0-1.4) |
| <b>Age at testing</b>        |            |     |                     |               |               |
| 18 - 24                      | 87 (74.4)  | 0.5 | 180.4 (146.2-222.6) | 1             |               |
| 25 - 29                      | 159 (73.3) | 1.0 | 161.4 (138.2-188.6) | 0.9 (0.7-1.2) |               |
| 30 - 34                      | 170 (71.1) | 1.0 | 162.4 (139.8-188.8) | 0.9 (0.7-1.2) |               |
| 35 - 39                      | 146 (72.3) | 1.0 | 153.5 (130.5-180.5) | 0.9 (0.7-1.1) |               |
| 40+                          | 178 (77.4) | 1.0 | 173.4 (149.7-200.9) | 1.0 (0.7-1.2) |               |
| <b>Baseline CD4</b>          |            |     |                     |               |               |
| <350                         | 344 (74.0) | 2.2 | 154.4 (138.9-171.6) | 1             | 1             |
| 350 - 500                    | 103 (74.1) | 0.6 | 169.6 (139.8-205.7) | 1.1 (0.9-1.4) | 1.1 (0.8-1.3) |
| ≥500                         | 109 (92.4) | 0.4 | 310.4 (257.3-374.5) | 1.7 (1.3-2.1) | 1.2 (1.0-1.5) |
| Missing                      | 184 (65.0) | 1.3 | 141 (122.0-162.9)   | 1.0 (0.8-1.1) | 0.6 (0.5-0.7) |
| <b>Education</b>             |            |     |                     |               |               |
| < Grade 12                   | 527 (73.0) | 3.3 | 160.6 (147.4-174.9) | 1             |               |
| ≥ Grade 12                   | 203 (75.5) | 1.2 | 176.4 (153.7-202.4) | 1.1 (0.9-1.3) |               |
| <b>Marital Status</b>        |            |     |                     |               |               |
| Single                       | 114 (74.5) | 0.7 | 165.5 (137.8-198.9) | 1             |               |
| In a relationship            | 483 (72.2) | 3.0 | 163.7 (149.7-179.0) | 1.0 (0.8-1.2) |               |
| Married                      | 119 (79.9) | 0.7 | 175.9 (146.9-210.5) | 1.0 (0.8-1.4) |               |
| Divorced/widowed             | 23 (69.7)  | 0.2 | 132.4 (88.0-199.3)  | 0.8 (0.5-1.3) |               |
| <b>Employment Status</b>     |            |     |                     |               |               |
| Unemployed                   | 386 (73.4) | 2.4 | 163.5 (148.0-180.6) | 1             |               |
| Employed                     | 351 (74.1) | 2.1 | 167.1 (150.5-185.5) | 1.0 (0.9-1.2) |               |
| <b># adults in household</b> |            |     |                     |               |               |
| Lives alone                  | 141 (69.1) | 1.0 | 144 (122.1-169.9)   | 1             | 1             |
| Two adult in home            | 442 (76.5) | 2.5 | 178.6 (162.7-196.1) | 1.2 (1.0-1.4) | 1.2 (1.0-1.5) |
| ≥ three adults               | 153 (70.8) | 1.0 | 153.2 (130.7-179.5) | 1.0 (0.8-1.3) | 1.1 (0.9-1.5) |
| <b>Travel time to clinic</b> |            |     |                     |               |               |
| ≤15 minutes                  | 415 (73.2) | 2.6 | 161 (146.3-177.3)   | 1             | 1             |
| 16-30 minutes                | 218 (70.3) | 1.5 | 146.9 (128.7-167.8) | 0.9 (0.8-1.1) | 0.9 (0.8-1.1) |
| >30 minutes                  | 107 (83.6) | 0.4 | 248.6 (205.7-300.4) | 1.4 (1.1-1.8) | 1.1 (0.9-1.4) |

1  
2 **Table 4 Demographic and clinical characteristics associated with initiating ART on the day of HIV**  
3 **diagnosis**

|                 | Immediate ART<br>n(%) | Crude RR<br>(95% CI) | Adjusted<br>RR (95% CI) |
|-----------------|-----------------------|----------------------|-------------------------|
| <b>Facility</b> |                       |                      |                         |
| PHC 1           | 8 (10.0)              | 0.3 (0.2-0.6)        | 1.5 (0.5-4.3)           |

|    |                                         |            |               |               |
|----|-----------------------------------------|------------|---------------|---------------|
| 1  |                                         |            |               |               |
| 2  |                                         |            |               |               |
| 3  | PHC 2                                   | 9 (17.7)   | 0.5 (0.3-1.0) | 2.1 (0.9-4.9) |
| 4  | PHC 3                                   | 35 (16.9)  | 0.5 (0.3-0.7) | 0.7 (0.4-1.0) |
| 5  | PHC 4                                   | 42 (33.6)  | 1             | 1             |
| 6  | PHC 5                                   | 46 (30.5)  | 0.9 (0.6-1.3) | 1.3 (0.8-1.9) |
| 7  | PHC 6                                   | 10 (7.8)   | 0.2 (0.1-0.4) | 0.3 (0.1-0.5) |
| 8  |                                         |            |               |               |
| 9  |                                         |            |               |               |
| 10 | <b>Months after policy announcement</b> |            |               |               |
| 11 | ≤3 months                               | 15 (10.9)  | 0.3 (0.2-0.6) | 0.2 (0.1-0.4) |
| 12 | 4-6 months                              | 19 (10.4)  | 0.3 (0.2-0.5) | 0.3 (0.2-0.5) |
| 13 | 7-9 months                              | 57 (24.5)  | 0.8 (0.6-1.1) | 0.8 (0.6-1.0) |
| 14 | ≥10 months                              | 59 (31.4)  | 1             | 1             |
| 15 |                                         |            |               |               |
| 16 | <b>Sex</b>                              |            |               |               |
| 17 |                                         |            |               |               |
| 18 | Male                                    | 44 (15.7)  | 1             | 1             |
| 19 | Female                                  | 106 (23.0) | 1.5 (1.1-2.0) | 1.3 (1.0-1.9) |
| 20 |                                         |            |               |               |
| 21 | <b>Age at testing</b>                   |            |               |               |
| 22 |                                         |            |               |               |
| 23 | 18 - 24                                 | 25 (30.5)  | 1.0           | 1.0           |
| 24 | 25 - 29                                 | 37 (23.1)  | 0.8 (0.5-1.2) | 0.8 (0.5-1.3) |
| 25 | 30 - 34                                 | 38 (21.5)  | 0.7 (0.5-1.1) | 0.8 (0.5-1.2) |
| 26 | 35 - 39                                 | 24 (16.3)  | 0.5 (0.3-0.9) | 0.7 (0.4-1.1) |
| 27 | 40+                                     | 26 (14.8)  | 0.5 (0.3-0.8) | 0.6 (0.4-0.9) |
| 28 |                                         |            |               |               |
| 29 | <b>Baseline CD4</b>                     |            |               |               |
| 30 |                                         |            |               |               |
| 31 | <350                                    | 44 (14.9)  | 1.0           | 1.0           |
| 32 | 350 - 500                               | 18 (19.8)  | 1.3 (0.8-2.2) | 1.0 (0.4-2.6) |
| 33 | ≥500                                    | 20 (20.6)  | 1.4 (0.9-2.2) | 1.1 (0.4-2.9) |
| 34 | Missing                                 | 68 (26.4)  | 1.8 (1.3-2.5) | 1.5 (0.6-3.7) |
| 35 |                                         |            |               |               |
| 36 | <b>Education</b>                        |            |               |               |
| 37 |                                         |            |               |               |
| 38 | < Grade 12                              | 107 (19.7) | 1.0           |               |
| 39 | ≥ Grade 12                              | 43 (22.4)  | 1.1 (0.8-1.6) |               |
| 40 |                                         |            |               |               |
| 41 | <b>Marital Status</b>                   |            |               |               |
| 42 |                                         |            |               |               |
| 43 | Single                                  | 17 (15.5)  | 1.0           |               |
| 44 | In a relationship                       | 117 (23.5) | 1.5 (0.9-2.4) |               |
| 45 | Married                                 | 16 (14.3)  | 0.9 (0.5-1.7) |               |
| 46 | Divorced/widowed                        | 0          |               |               |
| 47 |                                         |            |               |               |
| 48 | <b>Employment Status</b>                |            |               |               |
| 49 |                                         |            |               |               |
| 50 | Unemployed                              | 76 (18.9)  | 1.0           |               |
| 51 | Employed                                | 72 (21.5)  | 1.1 (0.9-1.5) |               |
| 52 |                                         |            |               |               |
| 53 | <b># adults in household</b>            |            |               |               |
| 54 |                                         |            |               |               |
| 55 | Lives alone                             | 30 (18.7)  | 1.0           |               |
| 56 | Two adult in home                       | 88 (20.5)  | 1.1 (0.8-1.6) |               |
| 57 | ≥ three adults                          | 30 (20.4)  | 1.1 (0.7-1.7) |               |
| 58 |                                         |            |               |               |
| 59 | <b>Travel time to clinic</b>            |            |               |               |
| 60 |                                         |            |               |               |
|    | ≤15 minutes                             | 77 (19.0)  | 1.0           | 1.0           |

|               |           |               |               |
|---------------|-----------|---------------|---------------|
| 16-30 minutes | 41 (18.3) | 0.9 (0.7-1.4) | 1.1 (0.8-1.6) |
| >30 minutes   | 32 (28.3) | 1.5 (1.0-2.1) | 1.3 (0.8-2.0) |

**Figure 1. Participants flow from screening to ART initiation in the first 30 days of care by ART policy periods**

**Figure 2. Median time to ART start in the first 30 days of HIV care by ART policy periods**

**Figure 3. Kaplan Meier curve of ART initiation in the first 30 days of HIV care by ART policy periods**

**Figure 4. Immediate ART uptake in the first 12 months of the SDI policy implementation**

For peer review only

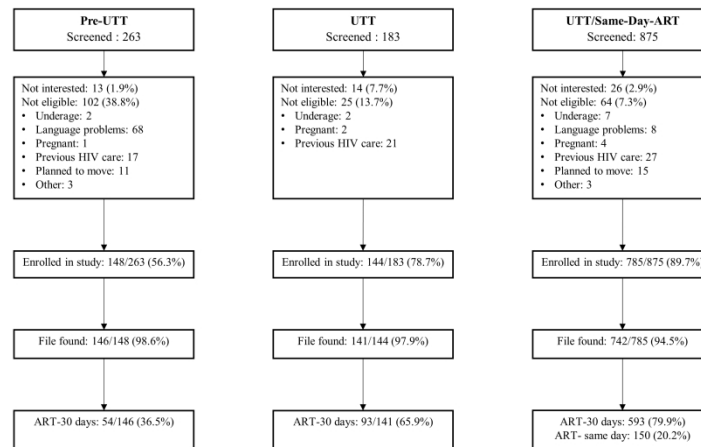
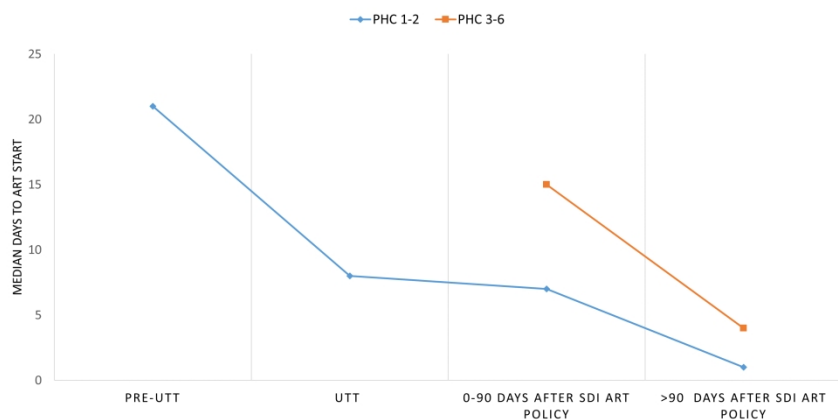
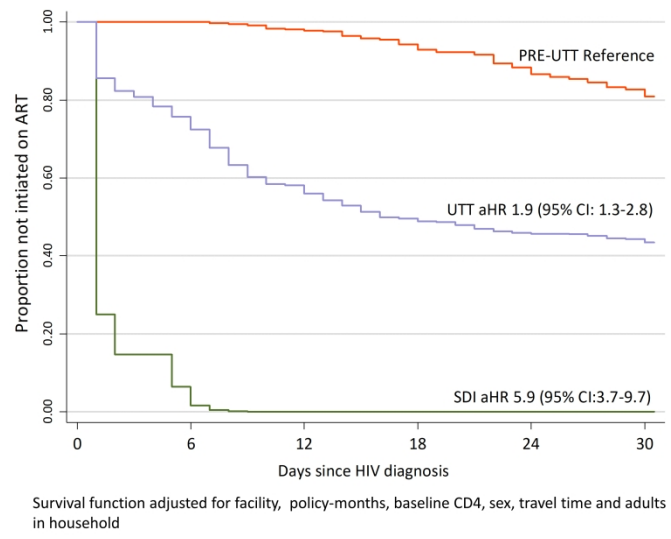


Figure 1. Participants flow from screening to ART initiation in the first 30 days of care by ART policy periods



Median time to ART start in the first 30 days of HIV care by ART policy periods

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



Kaplan Meier curve of ART initiation in the first 30 days of HIV care by ART policy periods

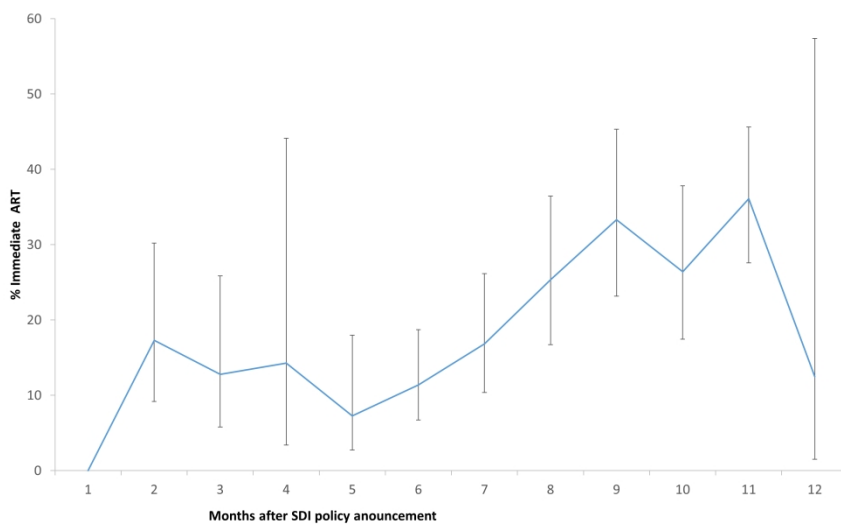


Figure 4. Immediate ART uptake in the first 12 months of the SDI policy implementation

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cohort studies**

| Section/Topic             | Item # | Recommendation                                                                                                                                                                       | Reported on page # |
|---------------------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| <b>Title and abstract</b> | 1      | (a) Indicate the study's design with a commonly used term in the title or the abstract                                                                                               | 2-3                |
|                           |        | (b) Provide in the abstract an informative and balanced summary of what was done and what was found                                                                                  |                    |
| <b>Introduction</b>       |        |                                                                                                                                                                                      |                    |
| Background/rationale      | 2      | Explain the scientific background and rationale for the investigation being reported                                                                                                 | 4-5                |
| Objectives                | 3      | State specific objectives, including any prespecified hypotheses                                                                                                                     | 5-6                |
| <b>Methods</b>            |        |                                                                                                                                                                                      |                    |
| Study design              | 4      | Present key elements of study design early in the paper                                                                                                                              | 5-6                |
| Setting                   | 5      | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection                                                      | 5-6                |
| Participants              | 6      | (a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up                                                           | 5-6                |
|                           |        | (b) For matched studies, give matching criteria and number of exposed and unexposed                                                                                                  |                    |
| Variables                 | 7      | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable                                             | 5-6                |
| Data sources/measurement  | 8*     | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 5-6                |
| Bias                      | 9      | Describe any efforts to address potential sources of bias                                                                                                                            | 6-7                |
| Study size                | 10     | Explain how the study size was arrived at                                                                                                                                            |                    |
| Quantitative variables    | 11     | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why                                                         | 6-7                |
| Statistical methods       | 12     | (a) Describe all statistical methods, including those used to control for confounding                                                                                                | 6-7                |
|                           |        | (b) Describe any methods used to examine subgroups and interactions                                                                                                                  | 6-7                |
|                           |        | (c) Explain how missing data were addressed                                                                                                                                          | 6-7                |
|                           |        | (d) If applicable, explain how loss to follow-up was addressed                                                                                                                       |                    |
|                           |        | (e) Describe any sensitivity analyses                                                                                                                                                |                    |
| <b>Results</b>            |        |                                                                                                                                                                                      |                    |

|                          |     |                                                                                                                                                                                                                                                                                                                                                                                                               |                           |
|--------------------------|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| Participants             | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed<br>(b) Give reasons for non-participation at each stage<br>(c) Consider use of a flow diagram                                                                                                               | 6<br>Figure 1<br>Figure 1 |
| Descriptive data         | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders<br>(b) Indicate number of participants with missing data for each variable of interest<br>(c) Summarise follow-up time (eg, average and total amount)                                                                                                                | 6<br>Table 2<br>5-6       |
| Outcome data             | 15* | Report numbers of outcome events or summary measures over time                                                                                                                                                                                                                                                                                                                                                | 6-7                       |
| Main results             | 16  | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included<br>(b) Report category boundaries when continuous variables were categorized<br>(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | <br>6-7, Table 2          |
| Other analyses           | 17  | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses                                                                                                                                                                                                                                                                                                                | Tables 2-4                |
| <b>Discussion</b>        |     |                                                                                                                                                                                                                                                                                                                                                                                                               |                           |
| Key results              | 18  | Summarise key results with reference to study objectives                                                                                                                                                                                                                                                                                                                                                      | 8-10                      |
| <b>Limitations</b>       |     |                                                                                                                                                                                                                                                                                                                                                                                                               |                           |
| Interpretation           | 20  | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence                                                                                                                                                                                                                                    | 10-12                     |
| Generalisability         | 21  | Discuss the generalisability (external validity) of the study results                                                                                                                                                                                                                                                                                                                                         | 10-12                     |
| <b>Other information</b> |     |                                                                                                                                                                                                                                                                                                                                                                                                               |                           |
| Funding                  | 22  | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based                                                                                                                                                                                                                                                 | 13                        |

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).