Hypertension Control and Retention in Care Among HIV Infected Patients: The Effects of Co-located HIV and Chronic Non-Communicable Disease Care

Supplemental Digital Content

Contents

Inclusion and Exclusion Criteria

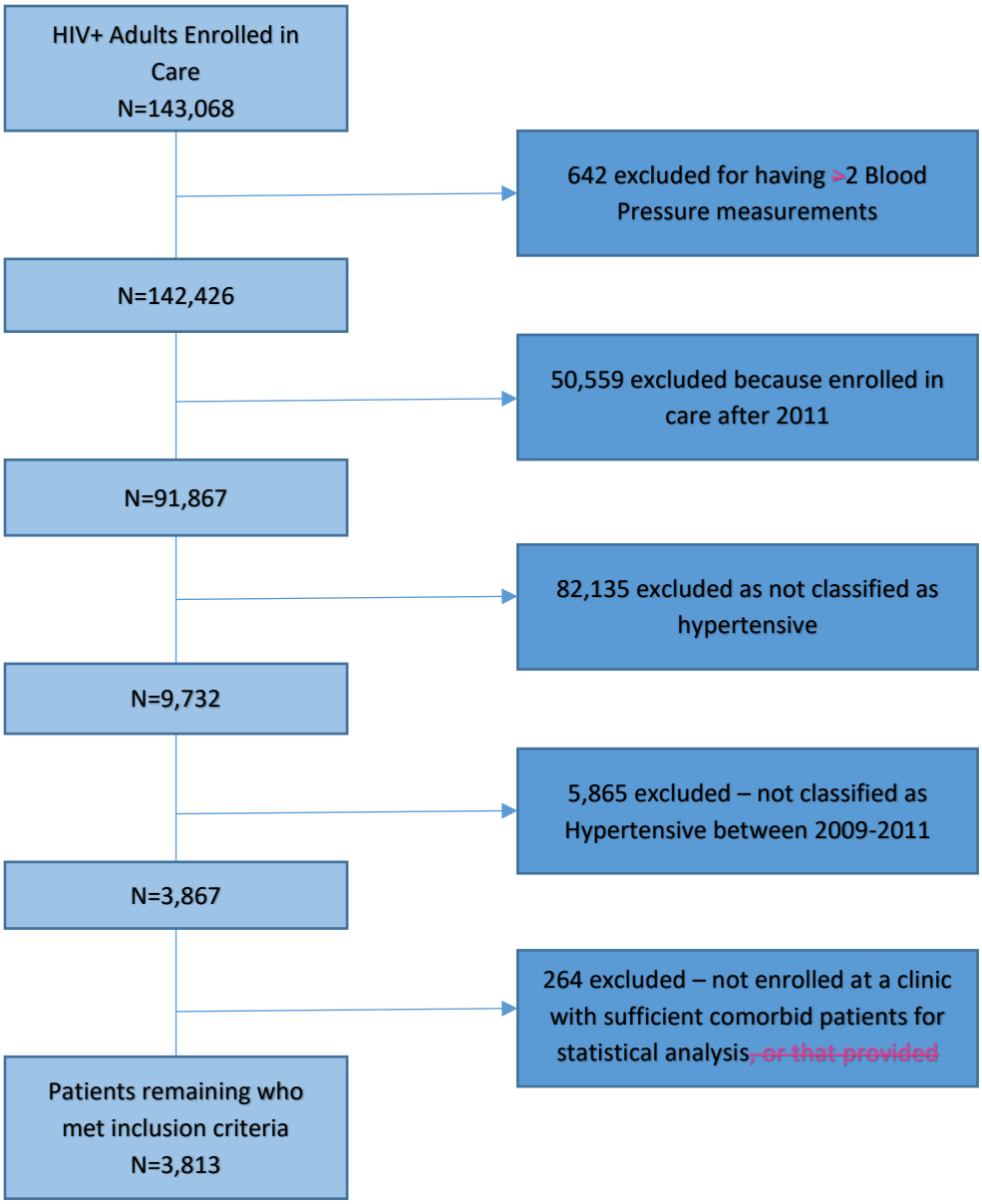

Figure A 1: Selection Criteria for Inclusion in Analysis

Terminal Digit Preference

The aging HIV epidemic introduces new challenges to care as co-morbid non-communicable diseases (NCD) are becoming a leading cause of morbidity and mortality among people living with HIV (PLWH). The addition of chronic NCD care to HIV programs has garnered support, but evaluation has been limited due to few appropriate comparators, poor data, and measurement issues. Improved precision in blood pressure reporting after the addition of NCD care may bias studies on the effectiveness of those programs. Imprecise blood pressure measurements and reporting may result in terminal digit preference (TDP) of zero, where significantly more measurements than statistically likely are recorded ending in zero. While itself a common problem in NCD management, changes in TDP in treatment groups may bias results. This study uses changes in proportion of blood pressure measurements without TDP as a proxy for precision in blood pressure reporting, and assess the changes associated with addition of NCD care.

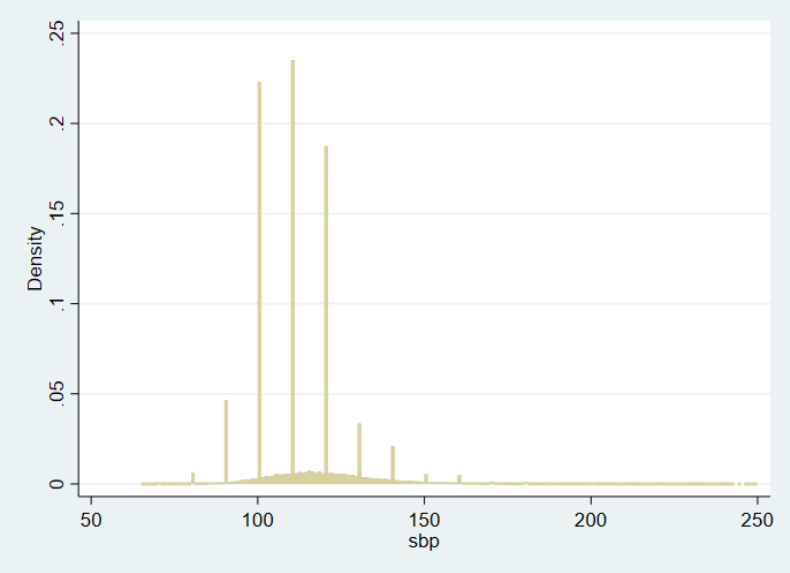

Figure A 2 Histogram of Systolic Blood Pressure Reports. Peaks are evidence of Terminal Digit Preference of zero

Beginning in 2011, the Academic Model for Providing Access to Healthcare (AMPATH) introduced collocated NCD care in some clinics across the care platform in western Kenya. From January 2007 to February 2017, there are 122,087 HIV patients with non-missing blood pressure measurements included in the AMPATH medical records system. Measurements are considered to have a TDP of zero if both systolic blood pressure and diastolic blood pressure measurements end in zero, or if one ends in zero and the other is missing. Groups are classified

as NCD added group if the clinic adds collocated NCD care during the follow up period, and comparison group if they do not.

Both treatment groups had similar proportions of TDP of zero for all years prior to the rollout, with consistent common trends (see figure A1). However, when NCD care was added in 2011, there is a 19 percentage point increase in non TDP measurements compared to the comparison clinics. Over time the proportion of TDP in both groups has fallen, and is equal as of 2017.

The addition of collocated NCD care is associated with a large and significant change in TDP. This change in reported blood pressure which may be due to the addition of automatic blood pressure gauges beginning in the clinics with collocated NCD care, increased training, or increased emphasis on precise blood pressure reporting. The magnitude of this change suggests that failure to accounting for this measurement issue would bias the evaluation of added NCD programs.

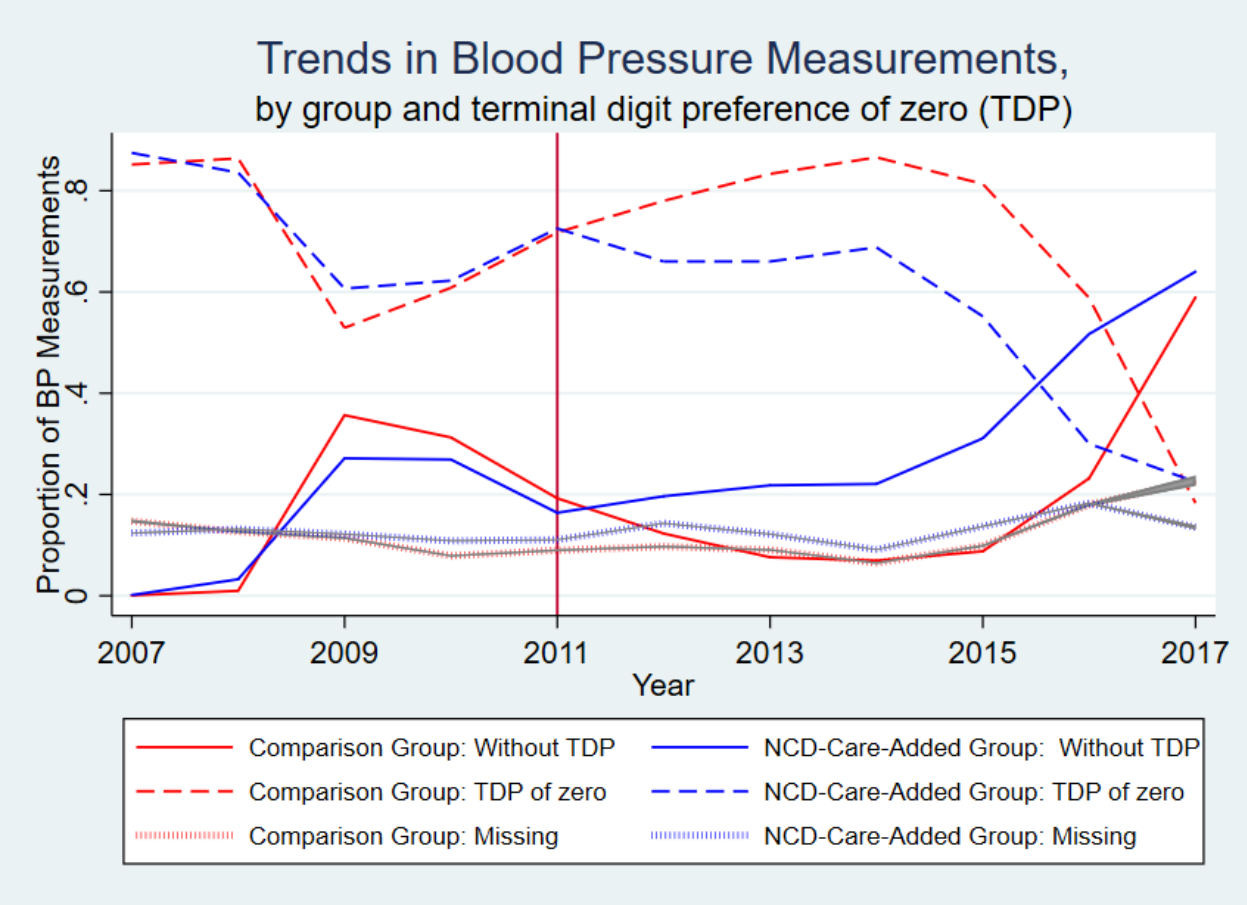

Figure A 3: Trends in Blood Pressure Measurements, by group and terminal digit preference of zero, from 2007 to 2017

Unadjusted Analysis:

Due to the above changes in trends in blood pressure measurements, the unadjusted analysis may provide a biased result. The unadjusted outcome tables are included below.

Table A1: Unadjusted Model from main analysis

	Blood Pressure Measurement		Hypertension Control		Adherence to Care	
	SBP (mmHg)	DBP (mmHg)	Per Visit BP <140/90 mmHg	Controlled >1 year	Adherent to Follow Up	Retained in Care
Added CDM	1.76^{***} [1.36,2.16]	-0.12 [-0.37,0.14]	-3.12^{***} [-4.11,-2.13]	6.20^{***} [5.62,6.78]	-1.60^{***} [-2.18,-1.03]	10.5^{***} [10.1, 10.9]
Obs.	104,137	104,169	104,077	135,730	109,455	135,999
Patients	3594	3594	3594	3601	3599	3603

95% confidence intervals in brackets * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Sensitivity Analysis

Excluding patients in CDM clinics that began the program after 2011.

We excluded patients in CDM clinics that rolled out the CDM program after 2011. The inclusion and exclusion criteria was chosen to best replicate a randomized control trial, but the length of time between the necessary enrollment cutoff for causal inference and the initiation of the program for some of the clinics was sometimes several years. The statistical model used should have accounted for the variable timing in treatment initiation, but some econometricians have pointed out possible risk of further bias. Therefore, we assessed the impact of the decision to include all in our primary analysis by restricting the intervention group to those attending clinics that initiated the treatment in 2011.

Our findings were consistent with the findings of the whole, though with a marginally larger magnitude. This is plausibly because the clinics that were first to roll out the program may have been selected as the preliminary clinics as they had the highest capacity to provide CDM care. However, the size of the difference is small.
patients in the CDM clinics that had the program begin during the year 2011 were most

Table A2: Adjusted Model Outcomes, excluding patients in CDM clinics that began the program after 2011

	Blood Pressure Measurement		Hypertension Control		Adherence to Care	
	SBP (mmHg)	DBP (mmHg)	Per Visit BP <140/90mm Hg	Controlled >1 year	Adherent to Follow Up	Retained in Care
Added CDM	-0.60* [-1.07,-0.13]	-1.28*** [-1.58,-0.97]	0.101 [-1.09,1.29]	7.21*** [6.49,7.93]	-2.21*** [-2.93,-1.49]	10.4*** [9.85,10.9]
Obs.	87,173	87,215	87,123	110,563	91,291	113,753
Patients	3099	3099	3099	3109	3104	3111

95% confidence intervals in brackets * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Excluding Patients with WHO Stage 4 HIV

Patients who are classified as WHO Stage 4 HIV were not included in this analysis. Compared to the main analysis, this only reduces the total sample by 194 people.

Table A3: Blood pressure and control Adjusted model, excluding patients with HIV WHO stage 4

	Blood Pressure Measurement		Hypertension Control		Adherence to Care	
	SBP (mmHg)	DBP (mmHg)	Per Visit BP <140/90mm Hg	Controlled >1 year	Adherent to Follow Up	Retained in Care
Added CDM	-0.54** [-0.95,-0.14]	-1.31*** [-1.57,-1.04]	1.11* [0.09,2.13]	6.14*** [5.52, 6.76]	-1.84*** [-2.44,-1.23]	9.49*** [9.04,9.93]
Obs.	95,025	95,054	94,969	120,118	99,919	123,010
Patients	3399	3398	3399	3406	3402	3408

95% confidence intervals in brackets * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Retention in Care

Patients are considered not retained in care if they have a gap in care of at least six months. This captures short term disengagement where patients can return to care within the follow up period, or long term loss to follow up, or death. AMPATH has a robust outreach program for patients who miss scheduled visits, including a standardized death reporting procedure and forms in the AMRS. [23] Due to the importance of all three components in retention in care, and incompleteness of death records, the main analysis used the composite measure. In this sensitivity analysis we repeated the analysis separately for each of the three outcomes that make up retention in care: short term disenrollment for patients who were not lost to follow up or had no record of death; lost to follow up if they have no record of death and no record of returning to AMPATH during the follow up period; and recorded death.

In all three cases, the policy has a significant reduction in the outcome. There is a 1.96 percentage point reduction in short term disengagement, a 7.06 reduction in loss to follow up, and a 4.15 percentage point reduction in death.

Table A4: Retention in Care

	Short Term Disengagement	Loss To Follow Up	Recorded Death
Added CDM	-1.96***	-7.06***	-4.15***
	[-2.23,-1.70]	[-7.42,-6.70]	[-4.37,-3.92]
Obs.	120,745	129,630	121,604
Patients	3603	3603	3603

95% confidence intervals in brackets
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Adherence to Care

We used a grace period for follow-up appointments that considered patients still adherent to the follow up schedule if they were in care within two weeks of their scheduled follow up appointment. To assess this assumption we also varied the length of the grace period by 3 days, 30 days, and 3 months. We also repeated it excluding patients after they have a reported death.

Table A5: Adherence Grace Period Definition Sub-Analysis

	3 Day Grace Period	1 Month Grace Period	3 Month Grace Period	3 Day Grace Period	1 Month Grace Period	3 Month Grace Period
Added CDM	5.90***	7.23***	11.9***	4.29***	5.31***	9.30***
Obs.	[5.15,6.66]	[6.62,7.84]	[11.4,12.3]	[3.53,5.05]	[4.71,5.92]	[8.90,9.69]
Excludes Known Mortality	No	No	No	Yes	Yes	Yes
Patients	132,235	132,235	132,235	128,621	128,621	128,621
Added CDM	3578	3578	3578	3574	3574	3574

95% confidence intervals in [brackets] * *p < 0.05,* ** *p < 0.01,* *** *p < 0.001*

[a] *The Added CDM are the dif-in-dif coefficients, which control for clinic effects, secular trends, time varying covariates, and patient covariates of age, sex, WHO stage, and ARV status*

[b] *Observations used in the analysis of each outcome.*

Sub-group Analysis

Stage 2 Hypertension at Baseline

Table A6: Difference-in-Difference Outcomes for blood pressure measurement, hypertension control, and adherence to care for patients with Stage 2 Hypertension (SBP> 160 or DBP>100) for first three measurements after hypertension diagnosis

	Blood Pressure Measurement		Hypertension Control		Adherence to Care	
	SBP (mmHg)	DBP (mmHg)	Per Visit BP <140/90mm Hg	Controlled >1 year	Adherent to Follow-up	Retained in Care
	-3.101***	-3.084***	4.41***	2.54***	6.15***	9.02***

Added CDM[a]	[-4.327,-1.875]	[-3.826,-2.341]	[1.93,6.89]	[1.49,3.58]	[4.43,7.88]	[7.86,10.2]
Obs.[b]	15,800	15,804	15,804	17,478	19,434	19,937
Patients	531	531	531	508	512	514

95% confidence intervals in [brackets] * *p < 0.05,* ** *p < 0.01,* *** *p < 0.001*

[a] *The Added CDM are the dif-in-dif coefficients, which control for clinic effects, secular trends, time varying covariates, and patient covariates of age, sex, WHO stage, and ARV status*

[b] *Observations used in the analysis of each outcome.*