



# Correlates of Blood Pressure Awareness, Treatment, and Control Among Adults 50 Years or Older by HIV Status in Northwestern Tanzania

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## Abstract

**Purpose of Review** The objective of this study was to describe the increasing incidence and risk of cardiovascular disease among persons living with HIV (PLWH) in Sub-Saharan Africa. We also used data to compare hypertension (a common NCD among PLWH) outcomes between PLWH and HIV–uninfected individuals among older adults in Northwestern Tanzania.

**Recent Findings** Hypertension is increasingly common in Sub-Saharan Africa and a leading cause of cardiovascular disease for PLWH. Among those with hypertension, PLWH have a 50% higher risk of incident myocardial infarction compared to the general population. In response to the rising incidence of these non-communicable diseases (NCDs) among PLWH, recently, the Joint United Nations Program on HIV/AIDS supported the integration of NCD care into routine clinical care for HIV. However, data are lacking on levels of awareness of hypertension status, diagnosis, and antihypertensive medication adherence.

**Summary** Given the higher likelihood of elevated blood pressure among PLWH, there is an urgent need to implement interventions to improve blood pressure control in this population. Researchers should evaluate treatment barriers at multiple levels including health system, healthcare providers, and patients' level and tailor evidence-based interventions to increase achievement of blood pressure control for PLWH.

**Keywords** Hypertension · HIV–associated comorbidities · Older adults living with HIV · Tanzania

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## Introduction

High systolic blood pressure is the leading risk factor for cardiovascular disease, and hypertension ranks first in burden of disease contributing to disability-adjusted life years worldwide [1]. Over the past two decades, there have been substantial investments in improving the prevention and management of HIV care in Sub-Saharan Africa, which have resulted in significantly lower prevalence of AIDS–related complications and mortality [2]. Subsequently, people living with HIV (PLWH) are surviving longer, but are facing increased risk for noncommunicable diseases (NCDs) that most often occur later in life [3, 4]. Hypertension is increasingly common in Sub-Saharan Africa and a leading cause of CVD among PLWH [5–7]. Large cohort studies have found that among those with hypertension, PLWH have a 50% higher risk of incident myocardial infarction compared to the general population and they often fail to meet treatment goals for blood pressure control [8–14, 15••].

In response to the rising incidence of NCDs among PLWH, recently, the Joint United Nations Program on HIV/AIDS supported the integration of NCD care into routine clinical care for HIV [17]. A recent study conducted in Cambodia and several Sub-Saharan African countries including Tanzania found that there were diverse approaches to NCD integration within and between countries [18]. For some, NCD services were integrated into centers providing HIV care; others were integrated into primary health care already offering NCD services, or simultaneously introduced new services that incorporated both HIV and NCD care. Each of these approaches presented unique benefits and potential barriers to implementation and program success [18].

In Tanzania, HIV clinics lack adequate infrastructure and human resource capacity to support the diagnosis and management of common NCDs such as hypertension [19]. In one study, Leung and colleagues recommended improving access to basic functioning equipment, introducing standardized treatment guidelines, and improving healthcare worker education. Beyond screening and diagnosis of NCDs for PLWH, there is also dearth of data on treatment including medication adherence and achievement of treatment goals for PLWH [20–22]. The gap in knowledge for the outcomes on continuum of NCD care among PLWH is critical for deploying targeted interventions at patient, healthcare provider, and health system levels. In this paper, we examined differences in outcome hypertension between PLWH and HIV–uninfected individuals for awareness, diagnosis, and treatment in Northwestern Tanzania.

## Methods

### Study Setting

This cross-sectional study was conducted between December 2018 and May 2019. PLWH were recruited from Bugando Medical Center (BMC) HIV Care and Treatment Center (CTC). BMC is one of the four zonal referral hospitals in Tanzania with 950 inpatient beds. The hospital has a catchment area of 14 million people, and the CTC serves over 4000 PLWH, typically with monthly clinic appointments and medication refills. PLWH who are diagnosed with hypertension continue to receive HIV care at the CTC and are referred to the BMC outpatient clinics for management of hypertension and follow-up. PLWH receive a referral note that they are expected to present to the outpatient clinics.

HIV–uninfected individuals were recruited at their neighborhood of residence, sampled from five wards across two districts (Nyamagana and Ilemela) in the BMC's patient catchment area.

### Participants

Globally applicable guidelines recommend that all older adults  $\geq 18$  years and persons at increased risk for high blood pressure (overweight or obese) should be screened for hypertension [23, 24]. Eligible participants in this study were older adults among adults 50 years or older who were HIV–uninfected and PLWH. The study received ethical approval from the Catholic University of Health and Allied Sciences (CREC/214/2017).

### Procedure

#### PLWH

PLWH were identified through appointment registers on their respective appointment days at the BMC CTC. PLWH were approached by the clinic nurse, informed of the study, and asked if they were interested in obtaining more information. PLWH who met the eligibility criteria and who expressed interest were referred to a private research office for informed consent procedures and enrollment.

#### HIV–uninfected individuals

In order to conduct community data collection at the different wards, the study team met with the chairperson of the ward to describe the study goals. These meetings were scheduled at least 3 days prior to beginning data collection. The chairperson then relayed the information to the community and encouraged participation. Dates and times that the study team would visit the wards were also provided by the chairperson. People living in each ward were gathered at one place and counseling pertaining to HIV and NCDs was given to all members prior to enrollment. Informed consent was obtained from all participants included in this study.

### Data Collection

Trained study personnel explained the study objectives in Swahili and obtained signed informed consent. After obtaining informed consent, an adapted version of the WHO STEPS Instrument for Non-communicable Disease Risk Factor Surveillance [25] was verbally administered in Swahili by the study personnel. The survey has sections that collect demographic information, history of NCDs in the family, and behavioral measurements like diet, physical activity, tobacco, and alcohol use.

### Health Screening

After completing the survey, study personnel screened all participants using standard procedures for hypertension,

obesity via measured body mass index (BMI), and HIV status [26–30]. Blood pressure was measured while the participant was in a sitting position, using an M4 Omron® automatic blood pressure machine. The blood pressure readings were taken from the left arm three times at 3-min intervals. The average of the two last readings was used to determine hypertension status in the analysis. Hypertension was classified as systolic blood pressure of  $\geq 140$  and or diastolic blood pressure of  $\geq 90$  mmHg.

Participant BMI was calculated by measuring their weight and height. Weight was measured using a SECA® weighing scales that were calibrated on a daily basis according to manufacturer's instructions. Height was measured using a SECA® stadiometer, while the participant faced forward. Participants were instructed to remove their shoes, caps, or head scarfs; keep their feet together; and stand with their arms by the sides.

HIV diagnosis was performed using rapid tests in a private room. There were two sequential immunochromatographic rapid tests, Determine™ HIV-1/2 (Alere Medical CO., Ltd Japan) for screening, followed by the UniGold® HIV-1/2 (Trinity Biotech, Bray, Ireland), for confirmation of a positive result. The survey and assessments took approximately 60 min to complete.

Those who were found to have elevated blood pressure were referred to the closest health center for management including BMC. Those who tested HIV-positive in the community were referred to the BMC CTC for further workup and ART initiation.

## Data Analysis

Data were analyzed using Stata statistical software version 15 (StataCorp). Descriptive statistics were used to summarize the study sample (see Table 1). We fit bivariate logistic regression models to assess for differences in characteristics between the two groups (PLWH and HIV-uninfected individuals). Correlates in the multivariable analysis were informed by prior literature on risk factors for hypertension in low-resource settings and included HIV status, gender, age, BMI, education level, relationship status, occupational status, smoking, and alcohol use. For multivariable analyses, three binary logistic regression models were fitted to assess the correlates of (i) being aware of hypertension status prior to the study, (ii) having elevated blood pressure at the time of the study, and (iii) among those who had been prescribed antihypertensive medication, whether or not they had taken the medication in the last 7 days. All associations were presented as adjusted odds ratios (aORs) with 95% confidence intervals (CIs).

## Results

### Participant's Characteristics

A total of 621 individuals  $\geq 50$  years or older participated in the study (Table 1). There were 321 (52%) PLWH and the rest were HIV-uninfected. There were no significant differences in the proportions of males and females between the two groups ( $p > 0.05$ ). There were also no differences in body mass index (BMI), occupation, and smoking status between the two groups ( $p > 0.05$ ). HIV-uninfected participants were significantly older ( $p < 0.001$ ), had lower levels of education ( $p < 0.001$ ), were less likely to be married ( $p < 0.001$ ), and were less likely to be employed ( $p = 0.01$ ). HIV-uninfected participants were also more likely to report a family history of hypertension ( $p < 0.001$ ) and less likely to report that they had their blood pressure checked ( $p < 0.001$ ).

### Hypertension Awareness, Diagnosis, Treatment, and Control by HIV Status

In bivariate analysis, the proportions of participants who were aware of their hypertension diagnosis did not differ significantly between the two groups (30% vs. 21%,  $p = 0.18$ ). Compared to HIV-uninfected participants, PLWH had increased odds of having elevated blood pressure (44% vs. 19%,  $p < 0.0001$ ). The odds taking antihypertensive medications in the past 7 days for those who were aware of their hypertension status did not differ significantly between the groups (30% vs. 17%  $p = 0.78$ ). Finally, the odds of having controlled blood pressure for those who were aware of their hypertension status was higher for HIV-uninfected compared to PLWH (55% vs. 26%,  $p < 0.0001$ ) (see Fig. 1).

### Predictors of Hypertension Awareness, Diagnosis, Treatment, and Blood Pressure Control

In multivariable analysis, HIV status was not associated with awareness of hypertension status [aOR 0.81 95% CI (0.49–1.37)] nor taking antihypertensive in the past 7 days [aOR 1.3 95% CI (0.64–2.66)]. PLWH were nearly four times more likely to have elevated blood pressure [aOR 3.93 95% CI (2.41–6.4)]. Gender, age, and marital status were all significantly associated with increased awareness of one's hypertension status. For example, being female was associated with three times higher odds of being aware of one's hypertension status [aOR 3.04 95% CI (1.78–5.19)]. Compared to individuals who were 50–55 years of age, those who were between the ages of 56 and 60 had increased odds of being aware of their hypertension status [aOR 1.80 95% CI (1.01–3.19)]. Compared to those who reported that they

**Table 1** Characteristics of study participants from BMC CTC and Nyamagana and Ilemela districts of Mwanza, Tanzania. *N* = 621

Characteristic	HIV status		<i>p</i> -value
	HIV-uninfected	PLWH	
<i>N</i>	300	321	
Sex			
Male	129 (43.0%)	130 (41.1%)	0.64
Female	171 (57.0%)	186 (58.9%)	
Age			
50–55 years	58 (19.3%)	144 (44.9%)	<0.001
56–60 years	60 (20.0%)	85 (26.5%)	
61–65 years	53 (17.7%)	53 (16.5%)	
66–70 years	44 (14.7%)	29 (9.0%)	
> 70 years	85 (28.3%)	10 (3.1%)	
Mean body mass index (BMI)	27.75	25.32	0.23
Education level			
No formal education	94 (31.3%)	44 (13.7%)	<0.001
<Primary education	53 (17.7%)	46 (14.3%)	
Completed primary education	124 (41.3%)	158 (49.2%)	
Secondary education or higher	29 (9.7%)	73 (22.7%)	
Marital status			
Cohabiting/married	14 (4.7%)	73 (22.7%)	<0.001
Separated/divorced/widowed	281 (94.0%)	190 (59.2%)	
Did not disclose	4 (1.3%)	58 (18.1%)	
Occupation			
Employed	13 (4.4%)	34 (10.6%)	0.010
Self-employed	171 (57.8%)	193 (60.3%)	
Retired	21 (7.1%)	21 (6.6%)	
Unemployed	61 (20.6%)	42 (13.1%)	
Homemaker	30 (10.1%)	30 (9.4%)	
Smoking status			
Never smoked	240 (80.0%)	263 (83.2%)	0.18
Living with smoker	3 (1.0%)	3 (0.9%)	
Current smoker	17 (5.7%)	7 (2.2%)	
Smoked in the past	40 (13.3%)	43 (13.6%)	
Alcohol use			
Never drank	182 (60.7%)	100 (31.2%)	<0.001
Stopped drinking	66 (22.0%)	169 (52.6%)	
Drinks alcohol	52 (17.3%)	52 (16.2%)	
Family history of hypertension	91 (32.5%)	57 (17.8%)	<0.001
Mean body mass index (BMI)	27.75	25.32	0.23
Ever had blood pressure checked	145 (48.3%)	223 (69.5%)	<0.001

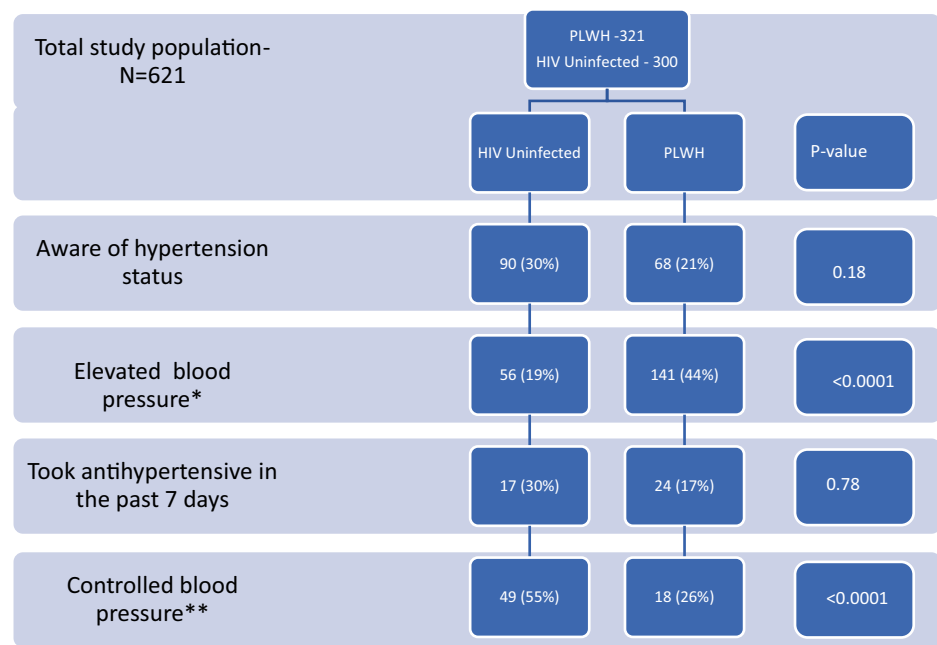
were cohabiting or married, those who did not disclose their marital status were less likely to be aware of their hypertension status [aOR 0.23 95% *CI* (0.08–0.67)].

Certain age groups and employment and smoking status were associated with having elevated blood pressure. Compared to individuals who were 50–55 years of age, those who were between the ages of 61 and 65 had increased odds of having elevated blood pressure [aOR 2.00 95% *CI* (1.13–3.58)] and compared to those who were employed, homemakers had increased odds of having elevated blood

pressure [aOR 3.2 95% *CI* (1.05–9.77)]. Compared to those who had never smoked, those who were current smokers and those who had previously smoked had lower odds of having elevated blood pressure [aOR 0.10 95% *CI* (0.01–0.84)] and [aOR 0.35 95% *CI* (0.16–0.77)], respectively.

Age, BMI, education, and marital status were associated with increased likelihood of taking antihypertensive medications in the past 7 days for those who were aware of their hypertension status and were prescribed antihypertensive medication. Compared to individuals who were 50–55 years

**Fig. 1** Hypertension awareness, diagnosis, treatment, and control by HIV status. \*Those who were screened and found to have elevated blood pressure. \*\*For those who were aware of their hypertension status



Those who were screened and found to have elevated blood pressure  
\* \*For those who were aware of their hypertension status

of age, those who were 56–60, 61–65, 66–70, and > 70 years old had increased odds of taking prescribed antihypertensive medication [aOR 3.27 95% CI (1.35–7.90)], [aOR 2.87 95% CI (1.08–7.62)], and [aOR 4.34 95% CI (1.49–12.63)], respectively. A unit increase in BMI was also associated with significantly increased odds of taking prescribed antihypertensives [aOR 1.01 95% CI (1.004–1.02)] (see Table 2).

## Discussion

Our analysis of the different stages of hypertension care continuum demonstrated that compared to HIV–uninfected individuals, PLWH were more likely to have elevated blood pressure. The groups did not differ significantly in their awareness of their hypertension status nor in their likelihood of taking prescribed antihypertensive medication. To the best of our knowledge, this is the first study to evaluate predictors of outcomes along the hypertension care continuum between older PLWH and HIV–uninfected individuals in Africa.

Although clinical guidelines recommend that older adults should be screened annually for hypertension [23, 24], in this study of 50 years or older individuals, less than one-third of the individuals in the two groups were aware of their hypertension status. Suboptimal adherence to guideline recommendations for screening may be related to low availability of equipment and human resource limitations in the healthcare system to screen for hypertension. In Tanzania,

studies have found that CTCs and general outpatient clinics lacked basic functioning equipment and that there were no standardized treatment guidelines for hypertension management [6, 19, 31]. Interventions should focus on increasing access to equipment and developing quality standards for hypertension screening and treatment referral. In this study, women and individuals older than 55 years were more likely to be aware of their hypertension status. Other studies in Sub-Saharan Africa have found similar associations in their populations [32–34].

Almost 70% of PLWH compared to 48% of uninfected individuals reported that they had previously had their blood pressure checked. Blood pressure is usually assessed in routine clinical practice at general outpatient clinic or CTCs, which means that regular engagement with the health system for HIV can present a valuable opportunity for screening. However, having one's blood pressure screened often did not contribute to improved knowledge of the person's current hypertension status. Future interventions should focus on fidelity of the screening process in these healthcare settings and for the assessments to be used for patient education which will more effectively inform clinical decision-making.

Compared to HIV–uninfected individuals, PLWH had almost four times increased odds of having elevated blood pressure. Other studies of relatively younger individuals have found similar associations [6, 35]. The higher likelihood of elevated blood pressure for PLWH may be related to the patterns of care for NCDs at the BMC CTC. The CTC provides HIV care while NCD care including hypertension requires

**Table 2** Correlates of hypertension awareness, elevated blood pressure, and self-reported antihypertensive medications taken among 50 years or older HIV-uninfected individuals and PLWH in Northwestern Tanzania

Characteristics	Aware of hypertension status N = 596		Elevated blood pressure N = 596		Took antihypertensive in the past 7 days N = 596	
	aOR	95% CI	aOR	95% CI	aOR	95% CI
<b>HIV status</b>						
HIV-uninfected	1.0		1.0		1.0	
PLWH	0.68	0.41–1.12	<b>3.93</b>	<b>2.41–6.40</b>	1.3	0.64–2.66
<b>Gender</b>						
Male	1.0		1.0		1.0	
Female	<b>3.04</b>	<b>1.78–5.19</b>	0.92	0.56–1.48	2.15	0.98–4.72
<b>Age</b>						
50–55 years	1.0		1.0		1.0	
56–60	<b>1.80</b>	<b>1.01–3.19</b>	1.61	0.97–2.67	1.15	0.45–7.96
61–65	1.81	0.96–3.42	<b>2.00</b>	<b>1.13–3.58</b>	<b>3.27</b>	<b>1.35–7.90</b>
66–70	<b>2.09</b>	<b>1.04–4.19</b>	1.93	0.99–3.75	<b>2.87</b>	<b>1.08–7.62</b>
> 70	<b>2.15</b>	<b>1.03–4.51</b>	1.29	0.60–2.77	<b>4.34</b>	<b>1.49–12.63</b>
BMI	1.01	0.99–1.01	1.00	0.99–1.01	<b>1.01</b>	<b>1.004–1.02</b>
<b>Education level</b>						
No formal education	1.0		1.0		1.0	
< Primary education	1.06	0.56–2.02	0.89	0.47–1.72	1.61	0.64–4.03
Completed primary education	0.81	0.47–1.39	0.97	0.57–1.67	1.27	0.56–2.90
Secondary education or higher	1.95	0.93–4.08	0.96	0.47–1.99	<b>3.57</b>	<b>1.30–9.87</b>
<b>Marital status</b>						
Cohabiting/married	1.0		1.0		1.0	
Separated/divorced/widowed	0.68	0.35–1.35	1.16	0.59–2.28	0.053	0.21–1.30
Did not disclose	<b>0.23</b>	<b>0.08–0.67</b>	0.98	0.40–2.38	<b>0.05</b>	<b>0.005–0.58</b>
<b>Occupation</b>						
Employed	1.0		1.0		1.0	
Self-employed	.081	0.34–1.92	1.23	0.48–3.14	1.13	0.29–4.45
Retired	1.07	0.35–3.23	0.73	0.21–2.57	1.03	0.21–5.30
Unemployed	1.12	0.43–2.90	0.68	0.23–2.02	1.19	0.26–5.33
Homemaker	0.71	0.26–1.95	<b>3.2</b>	<b>1.05–9.77</b>	1.08	0.23–5.03
<b>Smoking status</b>						
Never smoked	1.0		1.0		1.0	
Living with a smoker	2.84	0.50–16.2	0.91	0.12–6.73	1.44	0.14–14.97
Current smokers	0.31	0.07–1.47	<b>0.10</b>	<b>0.01–0.85</b>	0.38	0.05–3.9
Smoked in the past	1.02	0.50–2.06	<b>0.35</b>	<b>0.16–0.77</b>	0.21	0.04–1.03
<b>Alcohol use</b>						
Never drank	1.0		1.0		1.0	
Stopped drinking	1.11	0.68–1.75	1.04	0.62–1.76	0.92	0.47–1.80
Drinks alcohol	0.70	0.37–1.31	1.62	0.85–3.10	0.70	0.27–1.78

referral to the general outpatient clinic. Due to stigma associated with HIV, consultation fees, and challenges in finding time to schedule additional appointments, PLWH may be unwilling to complete their referral to the general outpatient clinic for hypertension care. Future research should focus on strategies to evaluate levels of referral completion, care coordination between the CTCs, and general outpatient clinics, and addressing barriers associated with the current referral process. A surprising finding was that current smoker and those who

reported that they had previously smoked had decreased odds of having elevated blood pressure compared to those who had never smoked. A possible explanation of the observed association may be that former smokers were aware of their risk for elevated blood pressure and implemented healthy lifestyle changes to reduce the likelihood of hypertension. Even though there was a statistically significant difference between non-smokers and current smokers in the likelihood of having elevated blood pressure, the results may have been influenced by



the different proportions within the smoking status categories. Only 2 out of 24 current smokers compare to 175 out of 503 nonsmokers had elevated blood pressure.

Taking antihypertensive medications was associated with increasing age, higher BMI, and being married. Increasing age, especially above the age of 60, has been found to be associated with antihypertensive medication adherence in other studies [36, 37]. Patients with increased BMI, which is a risk factor for cardiovascular diseases, may prompt them to be on medications and adherent to reduce adverse outcomes.

This study had several limitations. First, we recruited PLWH from one CTC and therefore the results may not be generalizable to other CTCs within Tanzania. Even though we made concerted efforts to recruit participants from the BMC catchment area, our group of PLWH was relatively younger, more educated, and more likely to be employed than the uninfected individuals. Although these variables were included in the multivariable models, it is possible that these factors, and not HIV status alone, may have contributed to the observed group differences in hypertension outcomes. The data on medication-taking behavior were self-reported and may be prone to recall bias.

## Conclusions

Our study was able to illuminate that older PLWH face many of the same health challenges in the hypertension continuum of care (awareness, diagnosis, treatment, and control) as older individuals in the general population [38, 39]. The finding that PLWH were more likely to have elevated blood pressure gives more impetus to clinicians and health service researchers to focus their efforts on interventions to reduce the likelihood of poor outcomes in these older adults. Implementation science researchers should evaluate treatment barriers that PLWH face and tailor evidence-based interventions to increase achievement of blood pressure control for PLWH. Some of the key questions for researchers and policy makers include the following:

1. What barriers at PLWH, providers, and health system levels contribute to the reduction of the likelihood of achieving blood pressure control?
2. What implementation strategies for integration of NCD care including hypertension management are feasible, acceptable, and sustainable in HIV care settings?
3. What implementation climate should be enhanced at HIV care settings in order to support integration of NCD care?
4. What PLWH and healthcare provider preference influences acceptability of NCD treatment in HIV care settings?

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## Declarations

**Conflict of Interest** The authors declare no competing interests.

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Papers of particular interest, published recently, have been highlighted as:

### ●● Of major importance

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