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Original Article

HIV viral load suppression amongst the incarcerated populations in Cameroon

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Abstract

Introduction: Despite increased national and international funding to combat the human immunodeficiency virus (HIV) pandemic, prison health services remain underfunded, resulting in poor HIV management among inmates. This study assessed viral suppression rates among HIV-positive inmates across four central prisons in Cameroon to evaluate the effectiveness of antiretroviral therapy (ART) in these settings.

Methodology: This cross-sectional study included four central prisons—prisons A, B, C, and D—each located in different regions of Cameroon. Data were obtained from patient records, and blood samples were collected from inmates eligible for viral load (VL) testing.

Results: A total of 268 inmates receiving first-line ART were enrolled. The overall viral suppression rate, defined as VL < 1000 copies/mL, was 89.9%. The suppression rates in the four prisons were 94.25%, 87.69%, 78.95%, and 50% for Prison C, D, A, and B, respectively. There was a strong association between viral suppression and the specific prison ($p < 0.001$). Inmates on dolutegravir (DTG)-based regimens had significantly higher suppression rates ($p = 0.027$). Moreover, prisons supported by the United States President's Emergency Plan for Acquired Immunodeficiency Syndrome (AIDS) Relief (PEPFAR) reported better suppression outcomes compared to non-PEPFAR-supported facilities ($X^2(1) = 13.28$, $p = 0.000268$).

Conclusions: These findings underscore the disparities in HIV care across correctional facilities and highlight the need for harmonized clinical management of HIV in prisons. Ensuring equitable access to comprehensive HIV services is essential for achieving the 95% VL suppression target among incarcerated populations.

Key words: incarceration; population; viral load; viral suppression; antiretroviral.

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Introduction

Key populations greatly influence the dynamics of the human immunodeficiency virus (HIV) pandemic as they play a crucial role in assessing the effectiveness of responses tailored toward HIV prevention and control. The Joint United Nations Programme on HIV/AIDS (UNAIDS) considers prisoners as part of the five key population groups that are particularly vulnerable to HIV and frequently lack adequate access to services [1]. There was 20% increase in the world prison population in 2000; and within the same year, it was estimated that around 3.8% of the global prison population were living with HIV [2]. According to UNAIDS, adults in jail are, on average, 5 times more likely to have HIV than adults in the general population [3]. The World Health Organization (WHO) estimates the difference to be even starker, and suggests that prisoners are 15 times more likely to be HIV-positive than those in the community [4]. HIV prevalence among females who are incarcerated in West and Central Africa is almost twice that of men (13.1% in females vs 7.1% in males) [5]. A systematic review conducted by UNAIDS in 2017 indicated that recent incarceration is associated with an 81% increase in HIV risk [4].

Antiretroviral therapy (ART) outcomes should be monitored by conducting HIV viral load (VL) testing on all persons living with HIV (PLWHIV) after 6 months of treatment initiation, and then at least once yearly [6]. There were many challenges while implementing this policy in sub-Saharan Africa, including donor and stakeholder coordination, transparent pricing, inconsistent reagent availability, instrument malfunction due to inadequate or lack of service and maintenance, and weak laboratory sample

referral networks [7] Although there has been a significant increase in national and international funding for HIV control, health services in prisons remain severely underfunded. Therefore, prison healthcare access is restricted because of a lack of equipment, transport, staff, infrastructure, and consumables such as diagnostic materials [8] Since there is a low priority for prison health in sub-Saharan Africa, the regions most affected with extraordinarily high rates of HIV are prison populations in South Africa (41%), Côte d'Ivoire (27.5%), and Zambia (27%). The UNAIDS country (Cameroon) 2018 facts sheet identified 27,800 inmates with an HIV prevalence of 4%. Prisoners are stigmatized, and the public is often ambivalent about providing quality care to those convicted, particularly in settings where public sector financing is limited [9].

There is low accessibility and availability of data on HIV VL monitoring in prisons, with limited communication with the outside world. This indicates that HIV-positive inmates are overlooked in any national HIV surveillance program. In this study, the level of HIV VL coverage in prisons were analyzed to determine if the 3rd 95 of the UNAIDS 95-95-95 target (which states that 95% of all people living with HIV know their HIV status, 95% of all people diagnosed with HIV receive sustained ART, and 95% of all people receiving ART have viral suppression) is attainable. The HIV viral suppression rate was assessed based on treatment regimen, gender, and the prison in which the inmate was incarcerated. It is important to note that, based on WHO regulations, PLWHIV are considered virally suppressed if their VL test is less than 1000 copies/mL.

Methodology

Study design

This cross-sectional study was carried out in 4 major central prisons. The prisons were named A, B, C, and D, as requested by the prison administration. Cameroon is administratively divided into 10 different regions, each with a central prison. The selected prisons are located in 4 different regions in Cameroon. Prison selection was based on the availability of the United States President's Emergency Plan for Acquired Immunodeficiency Syndrome (AIDS) Relief (PEPFAR) support and the prevalence of HIV in the various regions of Cameroon, as per data obtained from the district health information systems-2 (DHIS 2) database in March 2022. Two regions with a prevalence above, and two below the national average prevalence as of March 2022 were selected (Table 1). Prisons A and B were not supported by PEPFAR, while PEPFAR directly supported prisons C and D. Data was collected from the treatment file of each inmate. The data included the HIV treatment regimen initiation dates, and the last VL results within the previous 12 months. Blood samples were collected from inmates who were eligible for HIV VL testing as some inmates had never done any VL test since their initiation to ART.

Table 1. Prevalence of HIV within the prisons vs national prevalence.

Region/Prison	Prevalence of HIV in the region	Prevalence of HIV in prison	National prevalence of HIV
A	2.4	0.9	2.7
B	1.8	0.8	
C	3.8	3.7	
D	2.8	1.4	

HIV: human immunodeficiency virus.

Table 2. Distribution of inmates on ARVs by prisons.

Prison	Number of inmates on ARVs (%)
A	19 (7.1)
B	10 (3.7)
C	174 (64.9)
D	65 (24.3)
Total	268 (100)

ARV: antiretroviral.

Ethical statement

Ethical clearance was obtained from the Ethics Review Board of the Faculty of Health Sciences of the University of Buea (Reference number 2021/1260-01/UB/SG/IRB/FHS). The data presented in this article is extracted from a comprehensive study on the genetic diversity of HIV in prisons in Cameroon. Written and signed consent forms were obtained from all participants.

Study population

Access to prisons in Cameroon is very restricted. The study population included all HIV-positive inmates registered in the 4 major central prisons and who were on antiretrovirals (ARVs). The total number of inmates receiving HIV treatment in the 4 major prisons is presented in Table 2.

Sample collection, processing, transportation, and analysis

Whole blood samples were collected from each inmate on ARVs with no recent VL test results. The whole blood sample was centrifuged at 2500 rpm for 15 minutes to separate the plasma, which was then stored

Table 3. Comparison of mean ages of the inmates by prison.

Prisons	Count (%)	Mean age ± SE	Min	Max
A	19 (7.1)	39.2 ± 10.2	25	69
B	10 (3.7)	39.6 ± 11.0	27	59
C	174 (64.9)	39.5 ± 10.1	21	64
D	65 (24.3)	35.8 ± 9.8	19	65
Total	268 (100.0)	38.6 ± 10.1	19	69

SE: standard error; Min: minimum; Max: maximum.

in a freezer at – 40 °C. VL testing was performed using the Xpert HIV-1 Viral Load test kits from Cepheid on the GeneXpert (Sunnyvale, California, USA). The samples were analyzed based on the manufacturers' instructions. A total of 1.2 mL of plasma was added into the HIV VL cartridge and loaded into the GeneXpert module, and the results were obtained within 90 minutes [10,11].

Data analysis

The data was entered into Microsoft Excel version 2013 and saved as a comma-separated value file. The data were later exported into R statistical software (version 4.0.5), where it was cleaned, managed, and analyzed. Descriptive analyses were performed for each prison. The suppression rate per prison, regimen, and gender was analyzed, and the association was tested using the Pearson Chi-square test of independence. Logistic regression analysis was used to determine the effect of age, gender, ARV regimen, and the role of PEPFAR support on viral suppression.

Results

The overall mean (± standard deviation (SD)) age of the inmates was 38 (± 10) years, with a minimum age of 19 years and a maximum age of 69 years. The lowest mean (± SD) age per prison was 35.8 (± 9.78) years and recorded in prison D, with a minimum age of 19 years and a maximum age of 65 years. The highest mean (± SD) age per prison was 39.6 (± 10.99) years, recorded in prison B, with a minimum age of 27 years and a maximum age of 59 years (Table 3).

Data was collected from 268 inmates in 4 different prisons, and 238 (88.8%) were males. Most inmates were from prison C, 174 (64.9%); and the fewest were from prison B, 10 (3.7%). The majority (89.9%) of the inmates were on first-line ART comprising two nucleoside reverse transcriptase inhibitors (lamivudine and tenofovir disoprosil), and a single integrase strand transfer inhibitor (dolutegravir), dolutegravir/lamivudine/tenofovir (DTG/3TC/TDF). Only 10.1% of patients were taking efavirenz/lamivudine/tenofovir (EFV/3TC/TDF), a combination of two nucleosides reverse transcriptase inhibitors (lamivudine and tenofovir disoprosil) and one non-nucleoside reverse transcriptase inhibitor (efavirenz). No inmate was on second- or third-line ART.

The overall viral suppression rate among inmates was 89.9% (Table 4). The viral suppression rates per prison were as follows: prison C (94.25%), prison D (87.69%), prison A (78.95%), and prison B (50%). No inmates in prison B had performed a VL test, despite being on treatment for more than a year. Viral suppression was strongly associated with the prison in which the inmate was incarcerated ($p < 0.001$; Table 4). Viral suppression was also compared based on the type of antiretroviral the inmates were on. The suppression rate was 91.29% for patients on the DTG/3TC/TDF regimen, and only 77.78% for those on EFV/3TC/TDF. The suppression rate was higher in inmates on the integrase strand transfer inhibitor (dolutegravir) combination DTG/3TC/TDF ($p = 0.027$; Table 4). The suppression rate in females (93.33%) was slightly higher than that in males (89.5%), but the difference was not significant ($p = 0.51$; Table 4).

Table 4. HIV viral suppression rates by prison, ARV regimen, and gender.

Characteristic	Category	HIV viral suppression		Total	*p* value
		Suppressed n (%)	Unsuppressed n (%)		
Prison	A	15 (78.95)	4 (21.05)	19	< 0.0001
	B	5 (50)	5 (50)	10	
	C	164 (94.25)	10 (5.75)	174	
	D	57 (87.69)	8 (12.31)	65	
	Total	241 (89.92)	27 (10.08)	268	
Current ARV regimen	EFV/3TC/TDF	21 (77.78)	6 (22.22)	27	0.027
	DTG/3TC/TDF	220 (91.29)	21 (8.71)	241	
	Total	241 (89.92)	27 (10.08)	268	
Gender	Female	28 (93.33)	2 (6.67)	30	0.51
	Male	213 (89.50)	25 (10.50)	238	
	Total	241 (89.93)	27 (10.07)	268	

HIV: human immunodeficiency virus; ARV: antiretroviral; EFV/3TC/TDF: efavirenz/lamivudine/tenofovir; DTG/3TC/TDF: dolutegravir/lamivudine/tenofovir.

Table 5. Logistic regression analysis of inmate viral suppression.

Predictor variable	B	SE	Wald	*p* value	Odds ratio
Age	-0.042	0.023	3.233	0.072	0.959
Gender (1)	-0.845	0.821	1.06	0.303	0.43
Current regimen (1)	0.837	0.573	2.138	0.144	2.31
PEPFAR Support (1)	1.651	0.498	10.99	0.001	5.211
Constant	-1.837	1.128	2.651	0.103	0.159
Model $X^2 = 17.62$, $p = 0.001$					
Pseudo $R^2 = 13.3$					
n = 268					

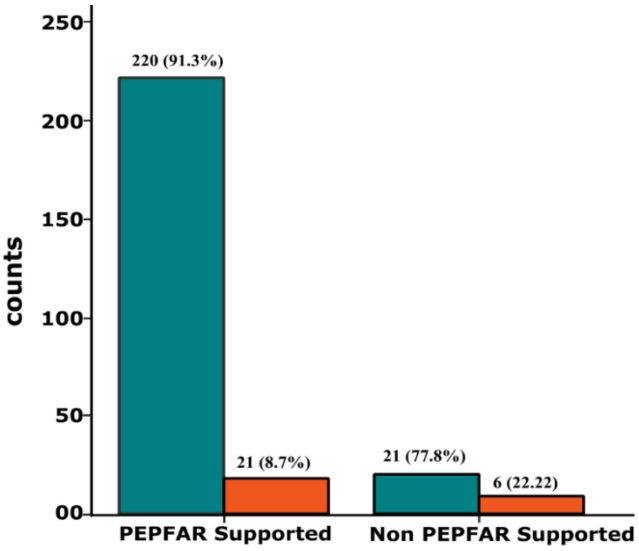
The dependent variable is viral suppression; coded so that 0 = suppressed and 1 = unsuppressed. SE: standard error; PEPFAR: United States President's Emergency Plan for Acquired Immunodeficiency Virus (AIDS) Relief.

The results of the logistic regression analysis (Table 5) were significant and demonstrated that the factors age, ARV regimen, gender, and PEPFAR support for the prison were associated with a strong likelihood of an inmate achieving viral suppression while on ARV therapy ($X^2[4] = 17.62$, p value < 0.01). The model explained 13.3% (Nagelkerke R-square) of the variance in viral suppression and correctly classified 89.9% of cases. PEPFAR support ($p = 0.001$) significantly added to the model; but increased age ($p = 0.072$), gender ($p = 0.303$), and treatment regimen ($p = 0.144$) did not significantly add to the prediction. The odds of viral suppression were 0.43 times less for males than for females (95% CI [0.086, 2.15]), when keeping all other predictor variables constant. When the age, gender, and PEPFAR support were kept constant, the odds of viral suppression were 2.31 times higher for inmates on a DTG/3TC/TDF-based regimen than for those on EFV/3TC/TDF (CI [0.75, 7.09]). When all factors were kept constant, the odds of viral suppression were 0.917 times less for an increase in age and 5.211 times higher for PEPFAR-supported inmates than for non-PEPFAR-supported inmates.

Table 6 illustrates some interesting findings on the structure and services rendered by the HIV treatment health units in the respective prisons. Most prison health units were poorly organized and had poor infrastructure. The national guidelines on HIV care were not fully implemented as some treatment units within the prisons were not recognized treatment units, and as such, they had not received adequate training on the care and management of PLWHIV. This was observed in prisons A and B which were not supported by PEPFAR.

Figure 1 shows that prisons with PEPFAR-supported healthcare facilities had significantly higher viral suppression rates among inmates than non-PEPFAR-supported sites. The suppression rate for PEPFAR-supported facilities was 92.5%, while rate was only 67% in non-supported facilities. This difference was statistically significant (X(1) = 13.28, $p < 0.0001$).

Figure 1. HIV viral suppression based on PEPFAR support site.



Green: suppressed; red: unsuppressed. PEPFAR: United States President's Emergency Plan for Acquired Immunodeficiency Virus

Table 6. Description of HIV treatment units within the prisons.

Prison	Infrastructure of the HIV treatment unit	Documentation of inmates' treatment	VL testing	Presence of PEPFAR IP
A	Poor	Inmates registered under different treatment healthcare facilities within the region (not a recognized treatment unit)	VL samples shipped to VL hub site, and then to reference laboratory	No
B	Moderate	Inmates registered in the treatment unit within the prison (recognized treatment unit)	VL testing not done	No
C	Moderate	Inmates registered in the treatment unit within the prison (recognized treatment unit)	VL samples shipped directly to the reference laboratory	Yes
D	Poor	Inmates registered in the treatment unit within the prison (recognized treatment unit)	VL samples shipped to a VL hub site, and then to a reference laboratory	Yes

HIV: human immunodeficiency virus; VL viral load; PEPFAR: United States President's Emergency Plan for Acquired Immunodeficiency Virus (AIDS) Relief;

Discussion

These results provide valuable insights into the demographic characteristics, treatment outcomes, and healthcare infrastructure of inmates living with HIV/AIDS in correctional facilities. The majority of inmates living with HIV/AIDS in the surveyed prisons were male, with a mean age of 38 years. There were variations in the age distributions among prisons, with prison B having the highest mean age (39 years) and prison D having the lowest (35 years). This variation may reflect differences in the inmate population composition and prison entry patterns.

The prison population was approximately 2083, 1200, 4736, and 4534, in prisons A, B, C, and D, respectively. The prevalence of HIV in prisons A (0.9%) and B (0.8%) was low, compared to prisons C (3.8%) and D (2.8%). The overall prevalence rate of HIV, 2.1%, was significantly lower than the global rate reported in 2019 (3.4%, and 0% in Bosnia and Herzegovina) [12]. Despite the high prevalence rate of 2.1% noted in this study, it was much lower than the alarming rates of 20% observed in Iran, Zambia, and Spain [12] It is challenging to explain the differences observed because the data indicating whether the inmates had the infection before conviction or acquired the infection in prison was not available.

The overall viral suppression rate among inmates on ART was 89.3%, which was lower than the 95% UNAIDS target, indicating deficiencies in treatment adherence. However, significant disparities in viral suppression rates were observed among prisons, with prison C exhibiting the highest rate (94.25%) and prison B the lowest (50%). In reviewing the literature, no data were found regarding the variation in suppression of VL in different prisons. Factors such as prison infrastructure, access to healthcare services, and adherence support mechanisms may contribute to these variations.

Most inmates were on first-line ART ((DTG/3TC/TDF)/TLD). However, a notable proportion of inmates were on efavirenz-based regimens (EFV/3TC/TDF)/TELE). Interestingly, a higher viral suppression rate among inmates on TLD regimen (91.29%) was observed compared to those on TELE (77.78%). This highlights the importance of regimen selection in achieving optimal treatment outcomes. Based on the limited data on VL suppression in the inmates, the results are similar to those obtained in 2023 by Fokam and colleagues, who observed a suppression rate of 91.8% and 86.4% for non-inmates on TLD and TELE, respectively [13].

The deficiencies observed in the organization and infrastructure of prison healthcare units underscore the need for improved healthcare infrastructure and adherence to national guidelines to ensure quality HIV care delivery within correctional facilities in Cameroon.

Prisons with PEPFAR-supported healthcare facilities (prisons C and D) demonstrated significantly higher viral suppression rates (92.5%) compared to non-supported facilities (prisons A and B; 67%). This shows the positive impact of external support in enhancing HIV care and management outcomes and calls for sustained investment in prison healthcare infrastructure and capacity-building initiatives.

Logistic regression analysis identified age, ART regimen, gender, and PEPFAR support as significant predictors of viral suppression among inmates. Notably, inmates receiving PEPFAR support had higher odds of achieving viral suppression, underscoring the importance of external funding and technical assistance in strengthening HIV care and management in correctional settings.

An important caveat to consider in this study is the low suppression rate in prisons A and B, where PEPFAR did not support the treatment centers. This could be worse for inmates incarcerated in prisons with no or little follow-up. In addition, data were obtained from 4 out of approximately 10 central prisons in Cameroon. All inmates on ARV participated in the study, except for Prison C, where only a few consented. In addition, data on initial VL, before initiation to treatment, and the number of years of incarceration were not captured. Further studies are being carried out to determine the genetic diversity of the HIV that circulates within the prisons.

Conclusions

This study underlines the importance of addressing systemic challenges in correctional healthcare systems to optimize HIV care and treatment outcomes among inmates. Targeted interventions, including improved infrastructure, adherence support mechanisms, and external funding support, are essential for achieving equitable access to quality HIV care in correctional facilities. Attaining 95% viral suppression in the country will require a one-health and all-inclusive approach, ensuring no one is left behind.

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Conflict of interests
No conflict of interests is declared.

References
1. Harm Reduction International (2018) The global state harm reduction 2018. Available: https://hri.global/wp-content/uploads/2022/10/global-state-harm-reduction-2018.pdf. Accessed: 10 June 2015.
2. Dolan K, Wirtz AL, Moazen B, Ndeffo-Mbah M, Galvani A, Kinner SA, Courtney R, McKee M, Amon JJ, Maher L, Hellard M, Beyrer C, Altice FL (2016) Global burden of HIV, viral hepatitis, and tuberculosis in prisoners and detainees. Lancet 388: 1089–1102. doi: 10.1016/S0140-6736(16)30466-4.
3. World Health Organization (2023) Global HIV, hepatitis and STIs programs. Available: https://www.who.int/teams/global-hiv-hepatitis-and-stis-programmes/populations. Accessed: 11 June 2025.
4. Stone J, Fraser H, Lim AG, Walker JG, Ward Z, MacGregor L, Trickey A, Abbott S, Strathdee SA, Abramovitz D, Maher M, Iversen J, Bruneau J, Zang Gm Garfein RS, Yen Y-F, Azim T, Mehta SH, Milloy M-J, Hellard ME, Sacks-Davis R, Dietze PM, Aitken C, Aladashvili M, Tsertsvadze T, Mravčík V, Alary M, Roy E, Smyrnov P, Sazonova Y, Young AM, Havens JR, Hope VD, Desai M, Heinsbroek E, Hutchinson SJ, Palmateer NE, McAuley M, Platt L, Martin NK, Altice FL, Hickman M, Vickerman P (2018) Incarceration history and risk of HIV and hepatitis C virus acquisition among people who inject drugs: a systematic review and meta-analysis. Lancet Infect Dis 18: 1397–409. doi: 10.1016/S1473-3099(18)30469-9.
5. World Health Organization (2016) Consolidated guidelines on HIV prevention, diagnosis, treatment and care for key populations. 2016 update. Geneva. Available: https://iris.who.int/handle/10665/246200. Accessed: 11 June 2025.
6. Dolan K, Moazen B, Noori A, Rahimzadeh S, Farzadfar F, Hariga F (2015) People who inject drugs in prison: HIV prevalence, transmission and prevention. Int J Drug Policy 26 Suppl 1: S12–15. doi: 10.1016/j.drugpo.2014.10.012.
7. Rich JD, Beckwith CG, Macmadu A, Marshall BDL, Brinkley-Rubinstein L, Amon JJ, Milloy M-J, King MRF, Sanchez J, Atwoli L, Altice FL (2016) Clinical care of incarcerated people with HIV, viral hepatitis, or tuberculosis. Lancet 388: 1103–1114. doi: 10.1016/S0140-6736(16)30379-8.
8. World Health Organization (2019) 13th general program of work (GPW13). Strategic partnership for health security and emergency preparedness (SPH). Available: https://extranet.who.int/sph/13th-general-programme-work-gpw13. Accessed: 11 June 2025.
9. Enggist S (2014) Good governance for prison health in the 21st century: a policy brief on the organization of prison health. WHO Regional Office for Europe, Copenhagen, Denmark.
10. Fuge TG, Tsourtos G, Miller ER (2022) Factors affecting optimal adherence to antiretroviral therapy and viral suppression amongst HIV-infected prisoners in South Ethiopia: a comparative cross-sectional study. AIDS Res Ther 19: 5. doi: 10.1186/s12981-022-00429-4.
11. Nash M, Huddart S, Badar S, Baliga S, Saravu K, Pai M (2018) Performance of the Xpert HIV-1 viral load assay: a systematic review and meta-analysis. J Clin Microbiol 56: e01673-17. doi: 10.1128/JCM.01673-17.
12. Sayyah M, Rahim F, Kayedani GA, Shirbandi K, Saki-Malehi A (2019) Global view of HIV prevalence in prisons: a systematic review and meta-analysis. Iran J Public Health 48: 217–226. doi: 10.18502/ijph.v48i2.816.
13. Fokam J, Nka AD, Dzukam FYM, Gabisa JE, Bouba Y, Tchouaket MCT, Ka'e AC, Semengue ENJ, Takou D, Moudourou S, Fainguem N, Pabo W, Mundo RAN, Ngueko ANK, Chenwi CA, Yimga JF, Zam MKN, Kamgaing RS, Tangimpundu C, Kamgaing N, Njom-Nlend A-E, Koki PN, Kesseng D, Tetang SN, Kembou E, Lifanda LE, Pamen B, Ketchaji A, Temgoua ES, Billong SC, Bissek A-C Z-K, Hadja H, Halle EG, Colizzi V, Perno C-F, Sosso SM, Ndjolo A (2023) Viral suppression in the era of transition to dolutegravir-based therapy in Cameroon: children at high risk of virological failure due to the lowly transition in pediatrics. Medicine (Baltimore) 102: e33737. doi: 10.1097/MD.0000000000033737.