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SORT IT SUPPLEMENT: POST-EBOLA RECOVERY IN WEST AFRICA

Did the 2014 Ebola outbreak in Liberia affect HIV testing, linkage to care and ART initiation?

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Setting: Health facilities providing human immunodeficiency virus (HIV) testing, care and treatment in Liberia.
Objective: To evaluate individuals aged ⩾15 years who were tested, diagnosed and enrolled into HIV care before (2013), during (2014) and after the Ebola outbreak (2015).
Design: A cross-sectional descriptive study.
Results: A median of 6930 individuals aged ⩾15 years per county were tested for HIV before the Ebola outbreak; this number declined by 35% (2444/6930) during the outbreak. HIV positivity remained similar before (7028/207 314, 3.4%) and during the outbreak (4146/121 592, 3.5%). During Ebola, HIV testing declined more in highly affected counties (68 035/127 468, 47%) than in counties that were less affected (16 444/23 955, 31%, $P < 0.001$). Compared to the pre-Ebola period, HIV testing in less-affected counties recovered more quickly during the post-outbreak period, with a 19% increase in testing, while medium and highly affected counties remained at respectively 38% and 48% below pre-outbreak levels. Enrolment for HIV care increased during and after the outbreak compared to the pre-Ebola period.
Conclusion: HIV testing and diagnosis were significantly limited during the Ebola outbreak, with the most severe effects occurring in highly affected counties. However, enrolment for HIV care and treatment were resilient throughout the outbreak. Pro-active measures are needed to sustain HIV testing rates in future epidemics.

By December 2015, the largest known Ebola virus disease (EVD) outbreak in history[1,2] had resulted in 10 666 cases and 4806 deaths in Liberia alone.[3] At least 184 health workers died, reducing the already deficient numbers in the country.[4] During the Ebola crisis, many health facilities were closed, hindering access to health services.[4] At the community level, changes in health-seeking behaviour and strict community quarantine may have affected access to health care,[5] including human immunodeficiency virus (HIV) testing, care and treatment. Likewise, the 'no touch' policy and suspension of invasive diagnostic and treatment techniques may have compounded this challenge.[6] Before the outbreak, 45% of HIV-infected persons in Liberia did not know their status.[7]

Although several reports and publications have shown how the Ebola outbreak impacted on health services and monitoring indicators,[4,8,9] its effect on HIV services in Liberia has not been comprehensively assessed. Establishing the effect of the outbreak is also important for HIV testing and management, as the current invasive HIV testing procedures had to be abandoned during the outbreak, when the 'no touch' policy was in effect.[6] A description of the effects of Ebola on HIV testing and care should contribute to a better understanding of the national HIV programme and provide insight into the programme's recovery process.

Our study sought to examine the effects of the outbreak on HIV services, with the specific objectives of comparing before, during and after the outbreak 1) the number of people aged ⩾15 years tested for HIV and the proportion diagnosed HIV-positive and enrolled in care, and 2) the number and proportion started on antiretroviral therapy (ART).

METHODS

Study design

This was a descriptive cross-sectional study using routine programme data.

Study setting

General settings

Liberia, a West African country covering a total area of 111 369 km^2, is bordered by Côte d'Ivoire, Sierra Leone, Guinea and the Atlantic Ocean. Administratively, it is divided into 15 counties, with an estimated population of 4 million;[4] 49% of the population is aged <15 years.[10] A third of the population lives in and around the capital, Monrovia, with 59% living in urban areas.[11] Life expectancy in Liberia is 62 years;[7] 71% of the population live within 5 km of a health facility.[8] Liberia's gross domestic product is US$900 million.[12] The main economic activities of the populace include agriculture, mining, fisheries and street vending, with 56% of the population living in poverty.[13]

Human immunodeficiency virus programme in Liberia

In 2014, an estimated 33 000 people were living with HIV in Liberia,[14] with HIV prevalence in the general population estimated at 1.9%.[7] In the last decade, the National AIDS Control Programme has significantly scaled up HIV testing, care and treatment services. In the 1990s, these services were available only in Monrovia at a few private health facilities. The services have now been expanded to all 15 counties, with 54 health facilities offering comprehensive HIV care and

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treatment services, including counselling and testing, prevention of mother-to-child transmission (PMTCT) and ART, with at least one centre in each county.[15] PMTCT services are integrated into the antenatal care services. HIV testing is conducted mainly at voluntary counselling and testing centres, antenatal clinics (routinely focused on pregnant women), health facilities (with provider-initiated testing) and blood donation centres. Community HIV testing is done during outreach and big national events, including World AIDS Days. However, during the Ebola outbreak such events were discouraged, as HIV testing was prevented by the 'no touch' policy. Although HIV testing continued in the health facility setting, no outreach or community HIV testing was performed during the outbreak.

HIV-positive clients are generally referred to the nearest care and treatment centre for management. When enrolled for HIV care, patients are assigned a unique identification number. Psychosocial support, adherence counselling, physical examination and laboratory assessments are offered during visits to the care-and-treatment centres.[16] Liberia has adopted the 2010 World Health Organization (WHO) recommendations for a public health approach to HIV care.[17] In line with the national guidelines for integrated HIV services (3rd ed),[18] all HIV-infected individuals with CD4 counts < 350 cells/mm^3 or in WHO clinical Stages 3 and 4 irrespective of CD4 count, are eligible for ART. The fourth edition of the national guidelines recommends that all HIV-infected persons with a CD4 count of <500 cells/mm^3 be started on ART, and this has just started being scaled up countrywide. Furthermore, all patients with HIV and tuberculosis or hepatitis B co-infection are eligible for ART.[16] Cotrimoxazole prophylaxis is given to all HIV-infected persons in care.

Reporting of human immunodeficiency virus data in Liberia

Liberia's Ministry of Health (MoH) collects monthly service data, including for HIV, from all facilities, both public and private, on one integrated health facility reporting form. District Health Officers (DHOs) collect and deliver these forms to the County Health Team early the following month. Data Officers in each county health team enter the data into the web-based District Health Information System (DHIS-2, Olso, Norway) database by the fifteenth day of the following month.

Ebola outbreak and human immunodeficiency virus care in Liberia

In Liberia, the 2014 Ebola outbreak, the largest worldwide to date, started in March 2014 and left the country's health system in panic, with the public health services almost collapsing during this period.[9] Special treatment centres were created to respond to the crisis, and confirmed Ebola cases were isolated at these facilities. Some public health staff officers at these treatment centres were repurposed for the Ebola response.[9] While the Ebola response action had to start immediately, most health facilities did not have staff trained in infection prevention and control and Ebola case management,[9] and supplies of infection prevention equipment and personal protective equipment were limited.[9]

During the outbreak, all invasive techniques involving pricking and incision were discouraged by the strict 'no touch' policy among health providers.[6] HIV testing was thus implicitly discouraged. This policy, coupled with anxiety among health care providers, probably had a negative effect on HIV services.

Data quality

DHOs perform validation checks on the data before collecting reports from health facilities. Validation includes confirming the consistency of selected data elements. There are also built-in data validation rules in DHIS-2 to reduce data entry errors. Further checks for outliers are conducted online centrally, and feedback is provided to the counties. The county and central MoH monitoring teams perform data validation at regular intervals. This is done by visiting health facilities and comparing data from the DHIS-2 with what is recorded in the reports and ledgers at the health facilities.

Study population

The study population included all individuals aged ⩾15 years who attended health facilities providing HIV services and whose data were captured in the DHIS-2 database before (2013), during (2014) or after (2015) the Ebola outbreak.

Data variables

Data variables for the study included year, number tested for HIV, number HIV-positive, number newly enrolled in HIV care, number newly started on ART and number of health facilities reporting. The definitions of these variables are given in Table 1.

Analysis and statistics

Data were extracted from DHIS-2, exported to Excel, version 2010 (Microsoft Corp, Redmonds, WA, USA) and analysed using EpiData software, version 2.2.2.182 (EpiData Association, Odense, Demark). Data are presented in absolute numbers and proportions. Depending on the number of Ebola deaths during the entire outbreak in each county, these were categorised into highly (>70 deaths), moderately (10–70 deaths) and less (<10 deaths) Ebola-affected counties for the purposes of analysis. A list of these counties is given in Table 2.

Ethics issues

Ethics approval was obtained from the University of Liberia-Pacific Institute for Research, Monrovia, Liberia, and the Ethics Advisory Group of the International Union Against Tuberculosis and Lung Disease, Paris, France. As the study involved aggregated data collected in routine programme settings, individual consent was not necessary.

RESULTS

Of the expected number of monthly facility HIV reports, respectively 91% (512/564), 90% (572/636) and 92% (594/648) were received before, during and after the Ebola period. The number of individuals undergo-

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Conflicts of interest: none declared.

TABLE 1 Definition of variables captured in the study

Variables	Definitions
Year	The calendar year
Number tested for HIV	Number of individuals tested for HIV during the study period across all the centres in Liberia where HIV testing was being offered
Number HIV-positive	Number of individuals who tested positive for HIV among those who were tested and knowing their status for the first time
Number newly enrolled in HIV care	Number of HIV-positive individuals enrolled in HIV care for the first time. An individual with HIV is said to have been enrolled in care once he/she has been counselled for ART and is enrolled in the HIV care register
Number newly started on ART	Number of individuals who are started on ART for the first time, among those who are enrolled in the HIV care register
Number of health facilities reporting	These are aggregate yearly numbers of health institutions with HIV testing and care facilities, who filled in the online monthly reports during the study period

HIV = human immunodeficiency virus; ART = antiretroviral therapy.

TABLE 2 Categorisation of counties by level of Ebola infection, Liberia, 2013–2015

Highly affected counties*		Moderately affected counties*		Less-affected counties*	
County	Population†	County	Population†	County	Population†
Montserrado	1 240 692	Bomi	93 330	Grand Gedeh	138 974
Lofa	307 180	Gbarpolu	92 519	Grand Kru	64 255
Bong	369 998	Grand Bassa	245 969	Maryland	150 824
Margibi	232 910	Nimba	512 620	Revercess	79 339
Grand Cape Mount	140 991	Sinoe	113 603	River Gee	74 103
Total	2 308 039	Total	1 102 946	Total	529 034

*Highly affected counties = counties that reported >70 Ebola deaths during the entire outbreak; moderately affected counties = counties that reported 10–70 Ebola deaths during the entire outbreak; less-affected counties = counties that reported <10 Ebola deaths during the entire outbreak.
†Population data are 2013 projections based on the 2008 population census (estimated growth rate of 2.1).

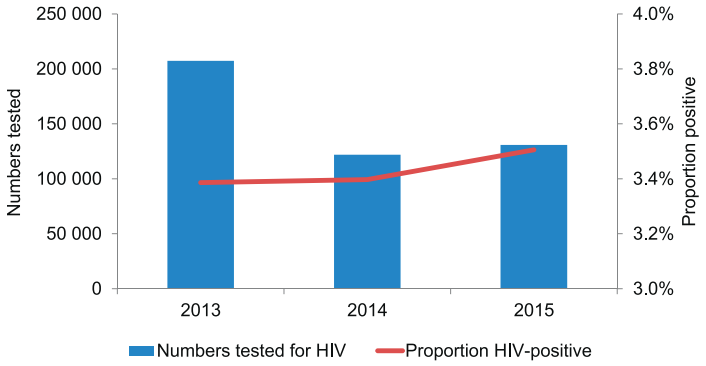

FIGURE 1 Testing and diagnosis of HIV infection before, during and after Ebola outbreak, Liberia, 2013–2015.* *2013 = pre-Ebola period; 2014 = Ebola period; 2015 = post-Ebola period. HIV = human immunodeficiency virus.

ing HIV testing and the number newly diagnosed as HIV-positive in all 15 counties before, during and after Ebola are shown in Figure 1. While a median of 6930 individuals per county were tested annually for HIV before the outbreak, this number declined by 35% (2444/6930) during the outbreak. However, the proportion found to be HIV-positive remained similar, at respectively 3.4% and 3.5%.

Table 3 gives the differences in numbers tested for HIV before, during and after the outbreak in counties grouped as less, moderately and highly affected by Ebola. During the outbreak, HIV testing declined more in highly affected counties (68 035/127 468, 47%) than in less-affected counties (16 444/23 955, 31%, $P < 0.001$). While the frequency of HIV testing in less-affected counties rebounded significantly during the post-Ebola period, rising to 19% above pre-Ebola reporting, post-Ebola HIV testing in medium and highly affected counties remained respectively 38% and 48% below pre-Ebola HIV testing levels.

TABLE 3 Comparison of HIV testing before, during and after the Ebola outbreak by highly affected counties vs. counties less affected by Ebola, Liberia, 2013–2015

Type of county*	Pre-Ebola†	During Ebola‡	Difference *n* (%)§	Pre-Ebola†	Post-Ebola¶	Difference *n* (%)#
Less affected	23 955	16 444	−7 511 (−31)	23 955	28 519	4 564 (19)
Moderately affected	55 891	37 473	−18 418 (−33)	55 891	34 447	−21 444 (−38)
Highly affected	127 468	68 035	−59 433 (−47)	127 468	67 915	−59 553 (−47)

*Less-affected = counties reporting <10 EVD deaths; moderately affected = reporting 10–70 EVD deaths; highly affected = reporting >70 EVD deaths.
†Numbers during 2013 (full year).
‡Numbers during 2014 (full year).
§Difference between the pre-Ebola and the Ebola periods.
¶Numbers during 2015 (full year).
#Difference between the pre-Ebola and the post-Ebola periods.
HIV = human immunodeficiency virus; EVD = Ebola virus disease.

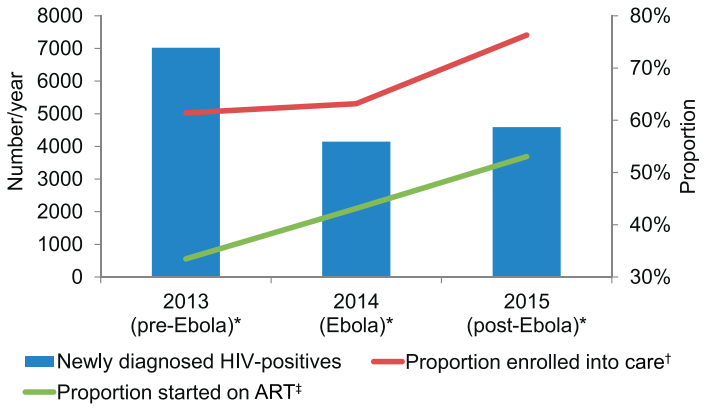

FIGURE 2 Numbers and proportions of newly diagnosed HIV-positive patients who were enrolled in care (includes medical care and psychosocial support for HIV-positive individuals who are on ART and those not on ART) and started on ART before, during and after the Ebola outbreak, Liberia, 2013–2015.†‡ *2013 = pre-Ebola period; 2014 = Ebola period; 2015 = post-Ebola period. †Number of newly diagnosed HIV patients enrolled in care. ‡Number of newly diagnosed HIV patients started on ART. HIV = human immunodeficiency virus; ART = antiretroviral therapy.

The numbers of newly diagnosed HIV patients enrolled in HIV care and ART are shown in Figure 2. While 61% (4311/7020) of newly diagnosed HIV patients were enrolled in care before the Ebola outbreak, the proportions during and after the outbreak were respectively 63% (2617/4143) and 76% (3501/4588, $P < 0.001$). Whereas 33% (2350/7020) of newly diagnosed HIV patients were started on ART before the Ebola outbreak, this proportion increased to 43% (1787/4143) during and 53% (2434/4588, $P < 0.001$) after the outbreak.

Table 4 shows enrolment into HIV care and start of ART before, during and after the outbreak in counties grouped as less, moderately and highly affected by Ebola. While the proportions enrolled in HIV care and started on ART gradually increased in the moderately and highly affected counties during and after the outbreak, these proportions decreased slightly in less-affected counties after the outbreak (–9% in enrolled in HIV care and –5% on ART compared to the Ebola period).

DISCUSSION

This is the first national study from Liberia to report on the effect of an Ebola outbreak on HIV testing, starting HIV care and ART. There were several important findings. First, the number of individuals tested for HIV during the outbreak fell by a third compared to before the outbreak. Although HIV testing gradually increased following the outbreak, it still did not rebound to pre-Ebola levels. Similar findings were observed with the numbers of persons newly tested as HIV-positive. Second, the decrease in numbers tested for HIV was more marked in highly Ebola-affected counties. While the less-affected counties were quick to recover in terms of numbers tested for HIV, highly affected counties showed no sign of recovery after the outbreak. Third, the enrolment of HIV-positive persons into HIV care and ART appeared resilient, and increased during and after the outbreak despite countrywide challenges.

One of the key strengths of the study is that it included all public and private health facilities providing HIV services. Furthermore, we adhered to the STROBE (STrengthening the Reporting of OBservational Studies in Epidemiology) guidelines and sound ethics principles for the conduct and reporting of the study.[19,20] As study limitations were related to the use of yearly aggregated data, we could not report on precise variability during the months when the outbreak was at its peak. Moreover, the continuum of care, which is important for long-term treatment such as HIV care, was not captured in the study. Finally, despite systematic multilevel validation procedures, data collection errors may have occurred.

The scarce availability of personal protective equipment and the closure of health facilities might have led to the decline in numbers tested for HIV and hence the diagnosis of new patients.[21] This decline was similar to that observed with HIV and TB diagnoses in Guinea.[22] Furthermore, the 'no touch' policy[6] may have discouraged HIV testing due to its invasive nature. The marked decline in HIV testing in highly Ebola-affected counties may have

TABLE 4 Comparison of HIV-infected persons enrolled in care and started on ART before, during and after the Ebola outbreak stratified by how much the counties were affected by the Ebola outbreak, Liberia, 2013–2015

	Pre-Ebola†	During Ebola§	Post-Ebola¶
Type of county*	*n*/*N* (%)‡	*n*/*N* (%)‡	*n*/*N* (%)‡
Enrolled into HIV care			
Less affected	688/989 (70)	423/562 (75)	684/1038 (66)
Moderately affected	720/1254 (57)	469/774 (61)	591/911 (65)
Highly affected	2903/4777 (61)	1725/2807 (61)	2226/2639 (84)
National total	4311/7020 (61)	2617/4143 (63)	3501/4588 (76)
Started on ART			
Less affected	276/989 (28)	233/562 (41)	377/1038 (36)
Moderately affected	369/1254 (29)	308/774 (40)	412/911 (45)
Highly affected	1705/4777 (36)	1246/2807 (44)	1645/2639 (62)
National total	2350/7020 (33)	1787/4143 (43)	2434/4588 (53)

*Less affected = counties reporting <10 EVD deaths; moderately affected = reporting 10–70 EVD deaths; highly affected = reporting >70 EVD deaths.
†Numbers during 2013 (full year).
‡Numbers during 2014 (full year).
§Difference between the pre-Ebola and the Ebola periods.
¶Numbers during 2015 (full year).
#Difference between the pre-Ebola and the post-Ebola periods.
HIV = human immunodeficiency virus; EVD = Ebola virus disease.

occurred because of the community's risk perceptions and the non-availability of contingency measures to maintain HIV testing services. HIV testing may also have been affected by the community quarantine and the horizontal nature of HIV testing services, which required regular health staff to do this work in addition to routine duties, which included dealing with the Ebola response. Mistrust of the community and health workforce, fear among health workers of contracting Ebola and interruptions in logistical support channels may also have played a role in the decline in HIV testing. Notwithstanding, the swift recovery of the HIV services in less Ebola-affected counties was encouraging. The inability of the highly affected counties to recover their HIV testing services suggests that a longer period may be needed, with additional support.

The resilience of enrolment into HIV care and start of ART during the outbreak was reassuring, given the general mistrust in the public health system during the outbreak.[9] This may have been due to several factors: 1) the acquired immune-deficiency syndrome (AIDS) programme established a refill and treatment centre at its head office in Monrovia, where the majority of the patients reside, to cater for their care and treatment needs; 2) other treatment sites around the country were based at hospitals that remained functional, and only a few experienced short-term or minimal disruption to supplies and commodities; 3) HIV services are vertical in nature, with dedicated staff to handle care and treatment, and these vertical services may indeed be more resilient and efficient when faced with health disasters such as Ebola; 4) the specialised nature of the ART and care centres with trained staff might have been less affected by the 'no touch' policy during the outbreak;[6] 5) newly diagnosed HIV patients might have been more willing to be enrolled in HIV care to prevent perceived worsening of symptoms that could have been misinterpreted as Ebola, thus leading to isolation in Ebola emergency centres; and 6) the recent change in national guidelines for ART initiation from CD4 count < 350 to < 500 cells/mm^3 may have affected the proportion started on ART at some centres; however, this criterion has not been scaled up countrywide.

This study has significant policy implications. First, pre-emptive measures need to be put in place to handle communicable diseases, including HIV, during any such outbreaks. These include innovative measures for non-invasive HIV testing, such as the use of oral saliva testing methodology.[23,24] Meticulous planning for logistics and resources to handle such outbreaks would pay dividends, as shown by a study from Guinea, where an efficient TB health programme was maintained without substantial service interruptions.[25] These lessons could be adopted to manage any future outbreaks. 'Targeted' HIV testing in combination with community-level HIV testing might also be considered, especially in the light of the prevailing low and concentrated HIV epidemic in the country.[26]

Second, the highly Ebola-affected counties need special attention in terms of support and proportionate distribution of resources to accelerate recovery. These counties may be further grouped based on population and individual HIV testing rates and require more intense review to understand the reasons for low post-outbreak HIV testing rates. Supportive supervision with a focused approach in these counties, with more advocacy, communication and mobilisation campaigns and enhanced logistical and resource planning, may help regain the pre-outbreak HIV testing levels. Initiatives may also be needed to motivate health staff, who might become complacent as a result of the relief felt once the Ebola outbreak finished.

In conclusion, this study has shown that HIV testing rates and numbers of patients diagnosed with HIV were severely suboptimal during the outbreak. While the findings were most striking in the highly Ebola-affected counties, recovery was also slow in these counties. The resilience of enrolment into HIV care and ART during the outbreak was reassuring. Pro-active actions are necessary to sustain HIV testing rates in future outbreaks, including exploring 'targeted' testing in combination with outreach and community HIV testing.

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Contexte : Structures de santé offrant des tests et une prise en charge de l'infection par le virus de l'immunodéficience humaine (VIH) au Liberia.
Objectif : Evaluer les personnes âgées de ⩾15 ans qui sont testées, diagnostiquées et enrôlées dans la prise en charge du VIH avant (2013), pendant (2014) et après la flambée d'Ebola (2015).
Schéma : Étude descriptive transversale.
Résultats : Une médiane de 6930 personnes âgées de ⩾15 ans par comté ont eu un test VIH avant la flambée d' Ebola ; ce nombre a décliné de 35% (2444/6930) pendant la flambée. La positivité du VIH est restée similaire avant (7028/207 314 ; 3,4%) et pendant la flambée d'Ebola (4146/121 592 ; 3,5%). Pendant Ebola, les tests VIH ont diminué davantage dans les comtés les plus affectés (68 035/127 468 ; 47%) comparés aux comtés moins affectés (16 444/23 955 ; 31% ; $P < 0{,}001$). Comparés à la période pré Ebola, les tests VIH dans les comtés les moins affectés ont récupéré plus rapidement pendant la période post flambée, avec une augmentation de 19% des tests, tandis que les comtés moyennement ou très affectés sont restés à 38% et à 48%, respectivement, sous les niveaux d'avant la flambée. L'enrôlement dans la prise en charge du VIH a augmenté pendant et après la flambée par rapport à la période pré Ebola.
Conclusion : Le test et le diagnostic du VIH ont été significativement limités pendant la flambée d'Ebola, avec l'impact le plus grave dans les comtés les plus affectés. L'enrôlement dans la prise en charge du VIH a toutefois été résilient tout au long de la flambée. Des mesures proactives sont requises pour maintenir le taux des tests VIH lors de futures épidémies.

Marco de referencia: Los establecimientos de salud que prestan servicios de diagnóstico, atención y tratamiento de la infección por el virus de la inmunodeficiencia humana (VIH) en Liberia.
Objetivo: Evaluar el número de personas de edad de ⩾15 años en quienes se practicó la prueba del VIH, se estableció el diagnóstico de infección por el virus y se inscribieron en el servicio de atención antes la epidemia de fiebre hemorrágica del Ébola (2013), durante el brote (2014) y después del mismo (2015).
Método: Fue este un estudio transversal descriptivo.
Resultados: La mediana del número de personas de edad de ⩾15 años en quienes se practicó la prueba del VIH antes del brote del Ébola por condado fue 6930; esta cifra disminuyó un 35% (2444/6930) durante el brote. La proporción de resultados positivos de la prueba permaneció estable antes del brote epidémico (7028/207 314 ; 3,4%) y durante el mismo (4146/121 592 ; 3,5%). Durante la epidemia del Ébola, la práctica de la prueba del VIH disminuyó más en los condados más afectados (68 035/127 468; –47%) que en los condados con una epidemia de menor nivel (16 444/23 955; –31%; $P < 0{,}001$). En comparación con el período pre-Ébola, la recuperación de la práctica de la prueba del VIH después de la epidemia en los condados menos afectados fue más rápida, con un aumento del 19%, pero en los condados donde la epidemia alcanzó un nivel intermedio o alto, las cifras permanecieron un 38% y un 48% inferiores al período pre-Ébola, respectivamente. La inscripción al programa de atención de la infección por el VIH aumentó durante el brote y después del mismo, en comparación con el período pre-Ébola.
Conclusión: Los resultados del presente estudio revelan que las pruebas y el diagnóstico de la infección por el VIH se redujeron de manera notable durante el brote epidémico del Ébola y los efectos fueron más acentuados en los condados donde la epidemia alcanzó un alto nivel. Sin embargo, la inscripción al programa de atención y tratamiento resistió durante toda la epidemia. Se precisan medidas anticipatorias que favorezcan la estabilidad de la práctica de la prueba diagnóstica del VIH durante las epidemias futuras.

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