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ORIGINAL ARTICLE

Investigating linkage to care following community-based screening for hepatitis B virus in rural Senegal: A mixed methods study

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Abstract

This paper investigates linkage to care following community-based screening for hepatitis B virus (HBV) in rural Senegal. HBV-positive participants who completed a biological and clinical examination to assess liver disease and treatment eligibility were referred to a regional hospital (if eligible for treatment), invited to join the Sen-B research cohort study (adults with detectable viral load) or referred to their local health centre (all others). Logistic regressions were conducted to investigate factors associated with (i) uptake of the scheduled post-screening examination, and (ii) HBV management initiation. Obstacles to HBV management were identified using thematic analysis of in-depth patient interviews. Of the 206 HBV-positive participants, 163 (79.1%) underwent the examination; 47 of the 163 (28.8%) initiated HBV management. Women, people not migrating for >6 months/year, individuals living in households with more agricultural and monetary resources, with other HBV-positive participants, and beneficiaries of the national cash transfer program, were all more likely to undergo the examination. The likelihood of joining the Sen-B cohort increased with household monetary resources, but decreased with agricultural resources. Initiation of HBV management in local health centre was higher among participants with a non-agricultural economic activity. Individuals reported wariness and confusion about HBV management content and rationale at various stages of the care continuum, in particular with respect to venous blood sampling and management without treatment. In conclusion, HBV community-based test-and-treat strategies are feasible, but early loss

Abbreviations: aOR, adjusted odds-ratios; CI, confidence interval; DBS, dried blood spots; HBsAg, hepatitis B surface antigen; HBV, hepatitis B virus; HDSS, Health and Demographic Surveillance System; IQR, interquartile range; pwHBV, people living with HBV; sSA, sub-Saharan Africa; WHO, World Health Organization; XOF, West African franc.

The members of the AmBASS study group are listed in the acknowledgments.

to follow-up must be addressed through simplified, affordable management and community support and sensitization.

KEYWORDS
chronic hepatitis B virus (HBV) infection, linkage to care, Senegal

1 | INTRODUCTION

With an estimated 990,000 new infections and 80,000 deaths in 2019, hepatitis B virus (HBV) infection is a major health issue in Africa. Significant gaps in HBV diagnosis and treatment in the region threaten the World Health Organization's (WHO) objective of elimination by 2030.[1] The latest WHO report recommends decentralized service delivery and close monitoring of the cascade of care to foster engagement, retention and treatment adherence.[2] Current international guidelines for HBV management include lifelong bi-annual monitoring, even in the absence of treatment eligibility.[3,4] However, this is particularly challenging to implement in resource-limited settings.[5] The 2024 Hepatitis B Treatment Guidelines update attempts to address this issue by significantly expanding treatment eligibility from approximately 10% to up to 50% of people living with HBV (pwHBV) and by including options to assess eligibility without viral load measurement or transient electrography.[6]

Senegal was one of the first countries in Western Africa to set up a national viral hepatitis program and to introduce hepatitis B vaccination. Part of the country's 2019–2023 strategic viral hepatitis plan is the decentralization of HBV care management, the aim being to expand access to HBV care to rural areas where over half the Senegalese population live.[7] In July 2019, the rural region of Fatick was appointed a pilot region for this decentralization process.[8] Effective decentralization of HBV care requires that all three pillars of the WHO elimination strategy—vaccination, testing and treatment—be implemented at the community level. Previous studies have documented the success of the infant vaccination program in rural Senegal[9] and there is some evidence for the acceptability and feasibility of community-based testing strategies for hepatitis B in the country.[10] However, large-scale testing and monitoring strategies are yet to be appraised in this context.[11]

In the present implementation research study, we investigated the first two steps of linkage to care in pwHBV following at-home community-based screening in a rural area in the Fatick region. Specifically, we examined the demographic and socioeconomic variables associated with (i) uptake of the scheduled post-screening biological and clinical assessment examination, and (ii) HBV management initiation in a health facility following referral by the study physician. We also analysed participant discourses on perceived obstacles to these two steps.

2 | MATERIALS AND METHODS

2.1 | Setting

The Niakhar Health and Demographic Surveillance System (HDSS) is located in the district of Niakhar in the Fatick region, Senegal. It covers approximately 45,000 individuals living in 30 villages.[12] Health posts in the three semi-urban villages covered by the HDSS (Diohine, Toucar and Ngayokheme) offer rapid HBV tests, while health centres in the towns of Niakhar (located just outside of the HDSS) and Fatick (located 10 km further south on an asphalt road) are responsible for routine HBV management of pwHBV not yet eligible for treatment. Those who are eligible receive treatment in the regional hospital, which is also located in the town of Fatick. Patients who develop HBV infection-related complications and those requiring further investigation (e.g. Fibroscan imagery) are referred to hospitals in the capital city Dakar, located 150 km northeast of Fatick town. Fann University Hospital is one such hospital. Since October 2019, it has enrolled adult pwHBV with a detectable viral load in a prospective cohort called SEN-B. Participants benefit from free routine HBV management and treatment (if eligible). In contrast, HBV management for pwHBV outside of the cohort (i.e. attending local health centres or Fatick regional hospital) is fee-based.

2.2 | Study design

The present implementation research study was nested within the ANRS12356 AmBASS project, a cross-sectional sero-survey conducted in the Niakhar HDSS between October 2018 and July 2019,[13] and the ancillary PeCSen study which continued until February 2022. Briefly, home-based HBV screening using dried blood spots (DBS) was offered to all residents of 301 randomly selected households living in the Niakhar HDSS. A total of 3118 participants agreed to be screened (individual participation rate 91.5%). Of these, 206 tested positive for hepatitis B surface antigen (HBsAg).[9] The overall study design is presented in Figure 1. Trained nurses first provided pre-test counselling and then collected a few drops of capillary whole blood on DBS. In parallel, interviewers collected detailed demographic and socioeconomic data using standardized questionnaires (see Appendix S1). Once the DBS results became available, the study physician provided post-test counselling to all the participants. A subsequent

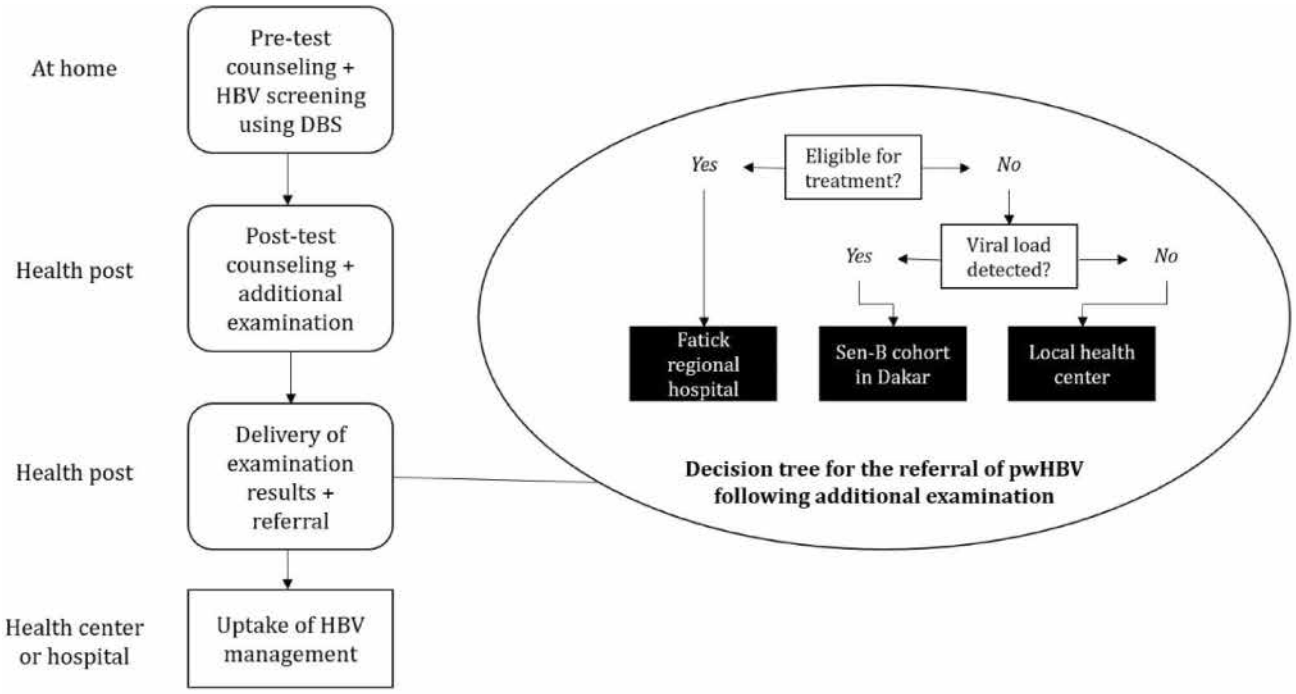

FIGURE 1 Flowchart of linkage to care following at-home screening for hepatitis B virus, Niakhar HDSS, Fatick region, Senegal, 2018–2022. DBS, dried-blood spots; HBV, hepatitis B virus.

biological and clinical examination was scheduled for pwHBV to assess liver disease stage (if any) and to determine treatment eligibility based on Senegal's national guidelines. The biological examination encompassed virological and serological examinations detailed in Appendix S1 (see 'Venous blood sampling'). Once available, the study physician shared the examination results in an individual interview and made referral recommendations depending on treatment eligibility, age and viral load measurement as follows: (i) participants (children and adults) eligible for treatment were referred to the Fatick regional hospital; (ii) adult participants not immediately eligible for treatment but who had a detectable viral load were invited to participate in the Sen-B study cohort at the Fann University referral hospital; (iii) all other participants were referred to their local health centre.

The study fully covered the treatment cost of approximately 8 USD per month (5000 West African franc (XOF)) per eligible participant, transportation costs to and from Dakar for those enrolled in the Sen-B cohort (a 5000 XOF flat fee, about 8 USD), and consultation costs of approximately 3 USD (2000 XOF) for patients referred to their local health centres.

PeCsen also included a qualitative study. Between July 2021 and February 2022, a PhD student in anthropology (CN) and a facilitator (AD) jointly conducted face-to-face semi-structured interviews with pwHBV (i.e. whether or not they had undergone the post-screening examination). Interviewees were selected using purposeful sampling ($n=35$). The interview guide was designed to explore obstacles to (i) uptake of the scheduled post-screening examination, and (ii) HBV management initiation following referral (see Appendix S2). Interviews were recorded and transcribed directly into French.

2.3 | Data analysis

Linkage to care for pwHBV was investigated using the following two outcomes: (i) uptake of the scheduled post-screening examination; (ii) HBV management initiation in the referral healthcare facility (defined as having completed at least one follow-up visit) in patients who had the post-screening biological and clinical examination.

We first conducted a descriptive analysis of the two outcomes and the main characteristics of the study population using numbers (percentages) for categorical variables and median [interquartile range, IQR] values for continuous variables. The second outcome was also described according to the three types of healthcare facility (local health centres, Fatick regional hospital and Fann University Hospital). We then explored the socio-demographic and economic variables associated with each of the two outcomes using univariable and multivariable logistic regressions. All variables with a p-value $<.20$ were considered for the multivariable models. Following a backward stepwise regression, the final multivariable models (i) retained variables significantly associated (p-value $<.05$), (ii) controlled for sex and age and (iii) excluded observations with missing variables (complete case analysis).

The analysis of the factors associated with the second outcome was stratified according to the two types of healthcare facility with the most referred patients – specifically local health centres ($n=85$) and Fann Hospital ($n=75$)—as we expected associated factors to be different between them. We also conducted a sensitivity analysis to consider only the adult study population (i.e. participants ≥18 years old at referral), and without facility stratification for the second

outcome. All the statistical analyses were performed using Stata version 16 for Windows (StataCorp).

Finally, a thematic analysis of the in-depth individual interviews was conducted to identify obstacles to each step (reflecting each outcome) in linkage to care.

3 | RESULTS

3.1 | Linkage to care following at-home HBV screening

Of the 206 participants who tested positive for HBsAg (189 adults and 17 children), 163 (79.1%) subsequently underwent the scheduled biological and clinical examination (see Figure 2). Seventeen explicitly refused to do so, 25 never visited the health post for the examination despite several call backs (labelled as 'absences'), and one died. Results from the post-screening examination indicated that three patients were immediately eligible for treatment, and that 74 had a detectable viral load and were therefore eligible to join the Sen-B cohort. The remaining 83 were not eligible for either of these management pathways and were therefore referred to their local health centres. The three treatment eligible pwHBV were driven to Fatick regional hospital for immediate care initiation; they were still receiving treatment in February 2022. Among those eligible to join the Sen-B research cohort, 29 (39.2%) did so. With regard to patients referred to their local health centres, 15 (16.9%) had initiated HBV management as of February 2022. Overall, 47 out of the 163 referred pwHBV (28.8%) initiated HBV management in one of the three types of referral health facility.

When considering only the adult study population, 147 out of 189 pwHBV (77.8%) had the post-screening examination. Of these, 44 (29.9%) initiated HBV management (3/3 referred to the regional hospital for treatment, 29/74 invited to join the Sen-B cohort and 12/70 referred to local health centres).

3.2 | Factors associated with patient uptake of post-screening examination

The factors associated with patient uptake of the post-screening examination are presented in Table 1. After adjusting for confounding factors, uptake was significantly associated with female sex (adjusted odds-ratio (aOR): 2.31; 95% confidence interval (CI): 1.02–5.23), no seasonal (i.e. >6 months/year) migration (aOR: 4.78; 95% CI: 1.16–19.64), living in a household with more agricultural (aOR: 2.31; 95% CI: 1.01–5.25) and/or monetary resources (aOR per one extra unit of the logarithm: 1.47; 95% CI: 1.09–1.99), benefiting from the Senegalese government's cash transfer program (aOR: 9.80; 95% CI: 1.24–77.41), and having at least one other HBsAg-positive household member (aOR: 3.11; 95% CI: 1.37–7.06). Results on adult pwHBV are presented in Table A3.1 in the Appendix S1.

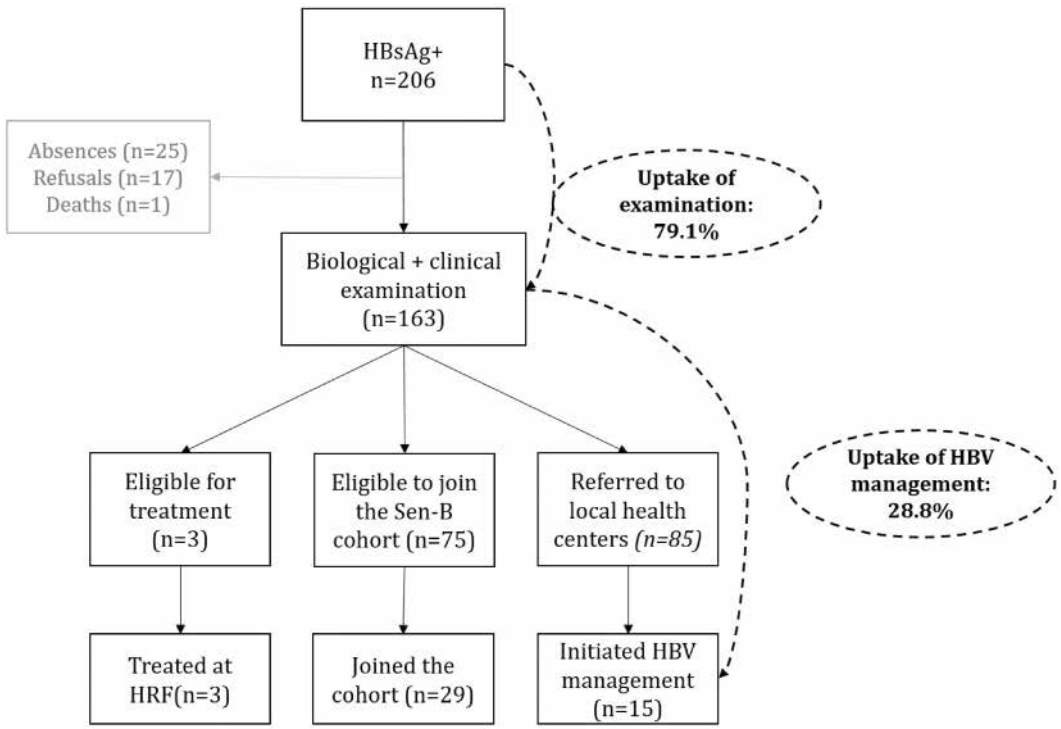

FIGURE 2 Linkage to care for participants testing positive for hepatitis B virus during at-home screening, Niakhar HDSS, Fatick region, Senegal, 2018–2022. HBsAg, hepatitis B surface antigens; HBV, hepatitis B virus; HRF, regional hospital in Fatick town.

3.3 | Factors associated with patient HBV management initiation

Tables 2 and 3 display variables associated with patient uptake of HBV management in the Sen-B research cohort, and in the local Niakhar or Fatick health centres. Following univariate regressions, education, agricultural resources (asset index of household-level agricultural resources, including crops, draught and feeder animals and farm equipment), monetary resources, fatigue during HBV screening, body mass index and family history of liver disease were all eligible to enter the multivariate model on HBV management initiation in the Sen-B cohort. In this model, factors significantly associated with joining the cohort were household agricultural resources (aOR: 0.28; 95% CI: 0.09–0.86) and monetary resources (aOR: 1.63; 95% CI: 1.08–2.47). For participants referred to local health centres, sex, household monetary resources and having a non-agricultural job were eligible to enter the multivariate model; the only factor significantly associated with HBV management initiation in this model was having a non-agricultural activity (aOR: 5.26; 95% CI: 1.27–21.73). The sensitivity analysis results are displayed in the Appendix S1—(Table A3.2).

3.4 | Obstacles to successful linkage to care

3.4.1 | Post-screening examination

Table 4 summarizes self-reported (i.e. qualitative interview-based) obstacles to uptake of the post-screening biological and clinical examination. Some participants did not attend the examination because of a lack of time or seasonal migration. Others refused to attend because (i) it involved venous blood sampling, (ii) they did not believe the positive screening result (absence of symptoms, confusion with the blood type) or (iii) they perceived that standard medicine was inappropriate, because they either believed traditional medicine was more suitable and effective in treating HBV, or that HBV was incurable.

3.4.2 | HBV management initiation

Self-reported obstacles to visiting a local health facility for HBV management after referral included limited economic resources (i.e. inability to cover out-of-pocket expenses) and low acceptability of HBV management that does not include treatment. For instance, one participant (HBV2795) described her condition as 'not serious' and 'forgot the appointment'. Participants eligible to join the Sen-B cohort encountered the widest variety of obstacles. Some were circumstantial, such as COVID-19-related restrictions, or momentary absence of the head of household (therefore no permission/financial support). Others were more permanent including a lack of economic resources and socio-cultural barriers. The latter included not obtaining permission from a spouse or guardian, not having a place to stay in Dakar, not knowing the Fann University hospital staff, and having no one to accompany them. In addition, participants (irrespective of the referral structure) reported wariness and confusion about HBV management content and rationale at various stages of the care continuum, in particular with respect to venous blood sampling and management without treatment (reflecting self-reports for the first outcome).

4 | DISCUSSION

In the context of HBV in rural sub-Saharan Africa (sSA), this is the first study to simultaneously (i) evaluate linkage to care both in centralized and decentralized settings, (ii) identify variables associated with the two first steps in linkage to care, specifically a biological and clinical examination following at-home screening, and management initiation following referral and (iii) report obstacles to HBV management initiation from the perspective of pwHBV.

Almost 80% of those who tested positive for HBsAg during at-home screening subsequently underwent the first linkage-to-care step (i.e. scheduled clinical and biological examination). This high percentage is consistent with previous findings in similar (i.e. community-based) HBV screening contexts (69.9% and 81.3% in the Thies region in Senegal, and in The Gambia, respectively[10,14]). Our results demonstrate that the first step uptake rate was just as high in a fully decentralized (i.e. local health posts) rural setting as in hospitals in mixed urban and rural settings. In contrast, less than 30% of HBV patients who underwent the clinical examination subsequently completed the second linkage-to-care step (i.e. HBV management initiation in a healthcare facility (all types)). This difference highlights significant and early loss to follow-up despite (i) post-test and post-examination counselling, (ii) HBV management facilitation through participation in the Sen-B cohort and (iii) compensation for consultation fees at local health centres. Although high rates of loss to follow-up among HBV patients have been reported in tertiary care hospitals in Saudi Arabia[15] and Pakistan,[16] the literature on this topic remains scarce, particularly in the sSA context. A study conducted in a district hospital in Sierra Leone reported a similarly low retention rate among patients enrolled in an HBV clinic integrated into chronic disease services.[17] Specifically, the authors documented a one-year retention rate of 32.3% among patients who were not on treatment at baseline, compared with 51.3% among patients who were on treatment at baseline.

Among factors associated with the two different steps of linkage to care we studied, women were significantly more likely to undergo the scheduled post-screening examination at a health post. However, female sex was not associated with joining the Sen-B cohort at Fann University hospital in Dakar. One possible explanation for this is that women were familiar with local health facilities thanks to antenatal consultations,[18] whereas consulting in Dakar might have involved having to ask for permission and/or having to find someone to accompany them (see citations above from HBV1160's spouse, and HBV1161's older brother). Combined with our result that the likelihood of joining

TABLE 1 Factors associated with uptake of scheduled biological and clinical examination by participants testing positive for hepatitis B virus during at-home screening.

Variable	Total number of HBsAg positive participants ($n=206$)	Number (%) who underwent bio-logical + clinical examination ($n=163$)	Crude OR (95% CI)	*p*-values	Adjusted OR (95% CI)	*p*-values
Sex						
Male	102	76 (46.6)	1.00		1.00	
Female	104	87 (53.4)	**1.75** (0.88–3.47)	.11	**2.31*** (1.02–5.23)	.05
Age (years)						
>20	63	54 (33.1)	1.00		1.00	
20–35	74	54 (33.1)	0.45 (0.19–1.08)	.07	0.55 (0.20–1.48)	.24
>35	69	55 (33.7)	0.65 (0.26–1.64)	.37	0.75 (0.26–2.19)	.60
Village type						
Semi-urban	143	111 (68.1)	1.00			
Rural	63	52 (31.9)	1.36 (0.64–2.91)	.43		
Had children ($n=205$)						
0–3	138	110 (67.9)	1.00			
>3	67	52 (32.1)	0.88 (0.43–1.79)	.73		
Education ($n=200$)						
None	92	72 (45.3)	1.00			
Primary/lower secondary	73	57 (35.8)	0.99 (0.47–2.08)	.98		
≥Upper secondary	35	30 (18.9)	1.67 (0.57–4.85)	.35		
Migration >6 months per year ($n=203$)						
Yes	14	7 (4.3)	1.00		1.00	
No	189	155 (95.7)	**4.56**** (1.50–13.85)	<.01	**4.05*** (1.05–15.68)	.04
Agricultural resources[a]						
Poor	93	66 (40.5)	1.00		1.00	
Rich	113	97 (59.5)	**2.48*** (1.24–4.96)	.01	**2.31*** (1.01–5.25)	.05
Monetary resources (log)[b]	Continuous variable		**1.18** (0.93–1.49)	.17	**1.47*** (1.09–1.99)	.01
Non-agricultural activity						
No	147	119 (73.0)	1.00			
Yes	59	44 (27.0)	0.69 (0.34–1.41)	.31		
Beneficiary of cash transfer program[c]						
No	168	126 (77.3)	1.00		1.00	
Yes	38	37 (22.7)	**12.33*** (1.64–92.67)	.02	**9.80*** (1.24–77.41)	.03
Other HBsAg+ person in household						
No	85	61 (37.4)	1.00		1.00	
Yes	121	102 (62.6)	**2.11*** (1.07–4.17)	.03	**3.11**** (1.37–7.06)	<.01

Note: We included the following variables in the multivariable analysis: age, sex, migration >6 months per year, agricultural resources, monetary resources, beneficiary of national cash transfer program, other HBsAg-positive person in the household.Bold OR indicates a *p*-value < .20.

Abbreviations: CI, confidence interval; HBsAg, hepatitis B surface antigen; OR, odds ratio.

[a]Binary variable for higher versus lower half of an agricultural resources index, which was built using multiple component analysis on household level agricultural goods and production (crops, livestock, farming equipment, etc.).

[b]Sum of household monetary resources (XOF) including all individual income and earnings, and household monetary resources (agricultural sales, cash transfers received through the national program, etc.).

[c]Binary variable for households benefiting from the Senegalese national cash transfer program (*Programme National de Bourse de Sécurité Familiale*, BSF) at the time of at-home HBV screening.

**p*-value < .05. ***p*-value < .01.

TABLE 2 Factors associated with HBV management initiation among participants eligible to join the Sen-B cohort at Fann University Hospital in Dakar.

Variable	Total number of patients eligible to join the Sen-B cohort ($n=75$)	Number (%) of eligible patients who joined the cohort ($n=29$)	Crude OR (95% CI)	*p*-values	Adjusted OR (95% CI)	*p*-values
Sex						
Male	37	14 (48.3)	1.00		1.00	
Female	38	15 (51.7)	1.07 (0.42–2.72)	.88	1.18 (0.41–3.40)	.77
Age (years)						
>20	22	10 (34.5)	1.00		1.00	
20–35	26	10 (34.5)	0.75 (0.24–2.37)	.63	0.75 (0.20–2.82)	.68
>35	27	9 (31.0)	0.6 (0.19–1.91)	.39	0.35 (0.09–1.45)	.15
Village type						
Semi-urban	48	20 (69.0)	1.00			
Rural	27	9 (31.0)	0.7 (0.26–1.87)	.48		
Had children ($n=74$)						
0–3	47	16 (55.2)	1.00			
>3	27	13 (44.8)	1.80 (0.69–4.73)	.23		
Education level						
No formal education	37	11 (37.9)	1.00			
Primary/lower secondary	22	10 (34.5)	1.97 (0.66–5.89)	.23		
≥Upper secondary	16	8 (27.6)	**2.36** (0.71–7.90)	.16		
Migration >6 months per year ($n=74$)						
Yes	2	0 (0)	N/A	N/A		
No	72	29 (100)				
Agricultural resources[a]						
Poor	29	16 (55.2)	1.00		1.00	
Rich	46	13 (44.8)	**0.32*** (0.12–0.85)	.02	**0.28*** (0.09–0.86)	.03
Monetary resources[b] (log)	Continuous variables		**1.58*** (1.07–2.32)	.02	**1.63*** (1.08–2.47)	.02
Non-agricultural activity						
No	56	23 (79.3)	1.00			
Yes	19	6 (20.7)	0.66 (0.22–2.00)	.46		
Beneficiary of cash transfer program[c]						
No	58	21 (72.4)	1.00			
Yes	17	8 (27.6)	1.57 (0.53–4.67)	.42		
Other HBsAg+ person in household						
No	26	11 (37.9)	1.00			
Yes	49	18 (62.1)	0.79 (0.30–2.09)	.64		

TABLE 2 (Continued)

Variable	Total number of patients eligible to join the Sen-B cohort ($n=75$)	Number (%) of eligible patients who joined the cohort ($n=29$)	Crude OR (95% CI)	*p*-values	Adjusted OR (95% CI)	*p*-values
Body mass index						
Normal	22	11 (37.9)	1.00			
Thinness	41	12 (41.4)	**0.41** (0.14–1.21)	.11		
Obesity	12	6 (20.7)	1.00 (0.24–4.08)	1.00		
Family history of liver disease						
No	67	24 (82.8)	1.00			
Yes	8	5 (17.2)	**2.99** (0.66–13.60)	.16		

Note: We included the following variables in the multivariable analysis: age, sex, agricultural resources and monetary resources. Bold OR indicates a *p*-value < .20.

Abbreviations: CI, confidence interval; HBsAg, hepatitis B surface antigen; OR, odds ratio.

[a]Binary variable for higher versus lower half of an agricultural resources index, which was built using multiple component analysis on household level agricultural goods and production (crops, livestock, farming equipment, etc.).

[b]Sum of household monetary resources (XOF) including all individual income and earnings, and household monetary resources (agricultural sales, cash transfers received through the national program, etc.).

[c]Binary variable for households benefiting from the Senegalese national cash transfer program (*Programme National de Bourse de Sécurité Familiale*, BSF) at the time of HBV screening.

*p-value < .05.

TABLE 3 Factors associated with HBV management initiation among AmBASS study participants referred to a local health centre.

Variable	Total number of patients referred to local health centres ($n=85$)	Number (%) of referred patients who initiated HBV management in local health centres ($n=15$)	Crude OR (95% CI)	*p*-values	Adjusted OR (95% CI)	*p*-value
Sex						
Male	36	4 (26.7)	1.00		1.00	
Female	49	11 (73.3)	**2.32** (0.67–7.98)	.18	**3.87** (0.98–15.28)	.05
Age (years)						
>20	30	5 (33.3)	1.00		1.00	
20–35	27	5 (33.3)	1.14 (0.29–4.45)	.85	0.60 (0.13–2.80)	.52
>35	28	5 (33.3)	1.09 (0.28–4.25)	.91	0.51 (0.11–2.45)	.40
Village type						
Semi-urban	61	11 (73.3)	1.00			
Rural	24	4 (26.7)	0.91 (0.26–3.19)	.88		
Had children						
0–3	60	12 (80.0)	1.00			
>3	25	3 (20.0)	0.55 (0.14–2.13)	.38		
Education ($n=81$)						
No formal education	35	6 (40.0)	1.00			
Primary/lower secondary	32	5 (33.3)	0.90 (0.24–3.28)	.87		
≥Upper secondary	14	4 (26.7)	1.93 (0.45–8.28)	.38		

(Continues)

TABLE 3 (Continued)

Variable	Total number of patients referred to local health centres ($n=85$)	Number (%) of referred patients who initiated HBV management in local health centres ($n=15$)	Crude OR (95% CI)	*p*-values	Adjusted OR (95% CI)	*p*-value
Migration >6 months per year						
Yes	5	1 (6.7)	1.00			
No	80	14 (93.3)	0.85 (0.09–8.18)	.89		
Agricultural resources[a]						
Poor	35	8 (53.3)	1.00			
Rich	50	7 (46.7)	0.55 (0.18–1.69)	.30		
Monetary resources[b] (log)	Continuous variable		**1.40** (0.94–2.09)	.10		
Non-agricultural activity						
No	61	8 (53.3)	1.00		1.00	
Yes	24	7 (46.7)	**2.73** (0.86–8.63)	.09	**5.26*** (1.27–21.73)	.02
Beneficiary of cash transfer program[c]						
No	66	13 (86.7)	1.00			
Yes	19	2 (13.3)	0.48 (0.10–2.34)	.36		
Other HBsAg + person in household						
No	35	7 (46.7)	1.00			
Yes	50	8 (53.3)	0.76 (0.25–2.34)	.64		
Body mass index						
Normal	29	5 (33.3)	1.00			
Thinness	48	8 (53.3)	0.96 (0.28–3.27)	.95		
Obesity	8	2 (13.3)	1.60 (0.25–10.36)	.62		
Family history of liver disease						
No	71	13 (86.7)	1.00			
Yes	14	2 (13.3)	0.74 (0.15–3.73)	.72		

Note: We included the following variables in the multivariable analysis: age, sex and non-agricultural activity. Bold OR indicates *p*-value < .20.

Abbreviations: CI, confidence interval; HBsAg, hepatitis B surface antigen; OR, odds ratio.

[a]Binary variable for higher versus lower half of an agricultural resources index, which was built using multiple component analysis on household level agricultural goods and production (crops, livestock, farming equipment, etc.).

[b]Sum of household monetary resources (XOF) including all individual income and earnings, and household monetary resources (agricultural sales, cash transfers received through the national program, etc.).

[c]Binary variable for households benefiting from the Senegalese national cash transfer program (*Programme National de Bourse de Sécurité Familiale*, BSF) at the time of HBV screening.

*p-value < .05.

the Sen-B research cohort in Dakar after referral increased with monetary resources, and that HBV management initiation in local health centres was more likely in individuals with a non-agricultural activity, our findings suggest that offering affordable decentralized HBV management is key to minimize gender and socioeconomic inequalities.

Qualitative studies conducted in Burkina Faso and Cameroon stressed that out-of-pocket costs associated with the assessment of treatment eligibility were a major obstacle to HBV management,[19,20] as was the lack of trained personnel and appropriate equipment. In this study setting, where assessment of treatment eligibility was free of charge, interviews with recently screened pwHBV revealed additional difficulties. In particular, they documented reluctance to repeated blood sampling as part of HBV management in persons not eligible for treatment. This suggests poor patient acceptability of current HBV guidelines in the context of rural Senegal. Finally, conflicting beliefs on traditional medicine and limited hepatitis B awareness—two dimensions already reported in rural Senegal[21]—highlighted that repeated counselling was insufficient to ensure initiation of HBV management in the absence of wider community-based sensitization.

Our study has several limitations. First, all the study participants resided in the Niakhar HDSS. Accordingly, our results are not generalizable to the whole of Senegal. Nevertheless, they provide a picture of current linkage to care in a rural sSA setting.

TABLE 4 Qualitative study: Thematic analysis of self-reported obstacles to linkage to care following at-home screening for hepatitis B virus.

Obstacle		Illustrative quote(s)
Uptake of proposed post-screening biological and clinical examination	Lack of time	When I went, they told me to that I'd have to get in the line to be able to retrieve the result. Since I was in a hurry, I left (HBV626)
	Migration/absence	It's because [when the project team arrived for] the next steps [they] didn't find me here, that's the reason. I was on holidays. (HBV406)
	Distrustful of the blood sampling required	I think that if they take a lot of blood, they give it to someone else (HBV182) There are some who say that the blood they take, it's not to treat you, but that they take it away (HBV1212)
	Doubt over at-home screening result/absence of symptoms	If I had this disease, I believe it would be very visible for those who consulted and examined me (HBV937) From what they explained, according to them, I have the hepatitis B virus. But for me, that's up in the air. Being B rhesus positive [blood type], I think … 'didn't they base themselves on that to say I have hepatitis B?' That's the question I'm asking myself (HBV1235)
	Traditional beliefs/ medication	We don't see it as something that you go to a doctor for; we say it's the witch doctors that attacked him, because we believe that the doctor can't cure it (HBV2909) They usually get cured at *Boudouk* (…) it's traditional medication. Over there, if you go before the disease destroys you inside, you'll get better (HBV1141)
	Belief that HBV is currently incurable	Whether you get treatment or not, you're going to die, therefore I'm not afraid (HBV1747)
HBV management initiation in a local health centre following referral	Limited economic resources	The last time I didn't go [was because] I had invested my money in something else (HBV196) Isn't it [the next visit] next month? *Interviewer: Are you going to go next month?* I don't think so… the fact that I'm not working anymore (HBV381)
	Absence of treatment as part of HBV management/ perception of a mild chronic condition	They told me that my infection was not very serious, that it was not necessary to begin treatment, but to go to Fatick. There, they gave me a follow-up appointment for 6 months times, and before the 6 months, I forgot the appointment (HBV2795)
	Little awareness/ knowledge of what is at stake in HBV management	They told me that they would bring—I don't know—this and that… what they said wasn't very clear (…) I didn't ask, I hadn't understood (HBV925)
HBV management initiation through inclusion in the Sen-B cohort at Fann University hospital in Dakar	COVID-19	I had to go to the Fann hospital; I told them I didn't think I would go, because it was at the time that they were talking about this disease [COVID-19] (HBV1160)
	Denied permission to initiate HBV management (collective decision-making)	It is my older brother who should have managed it, but he wasn't here… he's the one who gives me [*money*] to go…. he's the one who looks after me (HBV1161) I asked my husband, he told me he wasn't going to get into these things, because I couldn't go there, leave my work (HBV1160)
	Family duties	I said to myself 'If I go today, who am I going to leave at home?'. That's the problem…. before too, that was what handicapped me. I said to myself 'If I'm leaving for I don't know how many days I'm going to make and leave the house empty without a man or a woman'; that was my main problem (HBV1747)
	No housing or person to provide support in Dakar or to accompany them to Dakar	I told them I had no one that would be with me there (…) Going for visits and getting back… I don't have anywhere to stay, even though I lived in Dakar for a while, but I don't have any accommodation there (HBV937) Before going somewhere you need to know someone before. When you go there and you find a lot of people you don't know; you're not going to refuse to do everything they tell you. I said that I couldn't go there (HBV1160) Going to get treated without being with a relative… You don't know what they'll do to you; it's no safe… If you were with people that you know and that they would be there to hear and see what they [staff in Dakar] do to you… but being there alone, it's not very reliable (HBV1747)
	Low-level acceptability of HBV management without treatment	They didn't give me a vaccine or tell me to buy this prescription; that's what stuns me. And now, I hesitate to go to this [i.e. next scheduled] appointment, just like for the first appointment, to come and not go back… because taking someone's blood and not prescribing treatment, that's not treating (HBV2909)

Second, due to the small sample size of HBsAg-positive participants who initiated HBV management ($n = 15$ and $n = 29$ in local health facilities, and in the Sen-B research cohort, respectively), we had limited statistical power to identify factors associated with initiation. Finally, our study only documented initial HBV management, not medium or long-term real-world retention. However, our results suggest that retention was very low: for example, over the two-year period following initial referral, only three participants (i.e. 20%) of those who initiated HBV management in local care centres completed at least two of the three recommended six-monthly visits.[3,4]

Despite these limitations, this study sheds light on the challenges to HBV elimination in rural sSA, a region that constitutes a main 'reservoir' of the global HBV burden.[2] First, a 50% drop was observed between the number of people who underwent the examination assessing treatment eligibility (>79% acceptability) and the number who subsequently initiated HBV management in a healthcare facility after referral (<30%). Importantly, our results document that the acceptability of HBV management was particularly low for the majority of HBsAg-positive participants who were not immediately—and may never be—eligible for treatment. The rapid implementation of expanded treatment eligibility criteria following the recent update of WHO guidelines would likely address part of this problem. The updated guidelines also recommend the adoption of a differentiated care strategy as part of the decentralization of HBV management to primary care facilities. In these settings, simplified models could be based on a recent community-based 'same day screen and treat' pilot study conducted in Egypt.[22] Such simplification would most likely require prospective cohorts to first identify HBsAg-positive patients most at risk of developing complications,[23] and to incorporate innovative diagnostic tools and scores[24–26] that could replace repeated venous blood sampling and reduce out-of-pocket expenditures.

The second takeaway from our study is that it is imperative to strengthen community-based HBV sensitization and counselling in order to increase community awareness and provide socioeconomic support for HBV management, and retention in care. The literature on optimizing the continuum of care for viral hepatitis focuses primarily on HBV testing and HCV cure in high-income settings.[27] For other infectious diseases, community-based counselling and peer support have been associated with increased ART adherence among people with HIV,[28] stronger linkage to HCV care,[29] and greater patient empowerment in HIV prevention.[30] Community-based and integrated models of treatment and prevention[31] may therefore offer a way forward.

In conclusion, our results demonstrate that community-based test-and-treat strategies are feasible in rural sSA. However, the early and significant loss to follow-up we observed highlights the need for simplified, affordable HBV management, as well as community support and awareness, if viral hepatitis elimination goals are to be achieved. In rural sSA, this may require a combined implementation of (1) the WHO simplified guidelines for HBV treatment in primary health care settings such as health centres, (2) subsidies or coverage of follow-up exams and treatment costs and (3) community-based support, or peer counselling to improve retention.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to declare.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ETHICS STATEMENT

This research respects the ethical principles advanced by the current version of the Declaration of Helsinki, as well as regulations defined by legal and institutions bodies supervising research involving humans, and collection of personal data both in Senegal and in France—including the European Union General Data Protection Regulation. The study received ethical approval from the Senegalese National Ethical Committee for Research in Health (CNERS) no. 082MSAS/DPRS/CNERS on 10 April 2018, last renewed in July 2021, administrative authorisation from the Ministry of Health and Social Action and authorisation from the French Commission on Information Technology and Liberties (CNIL) reference MMS/ HG/OTB/AR181521.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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