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Applying the health capability profile to empirically study chronic hepatitis B in rural Senegal: a social justice mixed-methods study protocol

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ABSTRACT

Introduction Despite the early implementation of hepatitis B vaccination and the ongoing decentralisation of chronic hepatitis B (CHB) care, over 10% of the Senegalese adult population lives with CHB and liver cancer remains a main cause of death. Investigating factors associated with CHB infection, prevention of CHB-related morbidity, and prevention and treatment of mortality secondary to CHB calls for a holistic and multidimensional approach. This paper presents the adaptation of the health capability profile (HCP) to a specific epidemiological issue and empirical setting: it seeks to identify and analyse inter-related abilities and conditions (health capabilities) in relation to the CHB epidemic in the rural area of Niakhar, Senegal.

Methods and analysis This ongoing study relies on a sequential social justice mixed-methods design. The HCP is comprehensively adapted to CHB in rural Senegal and guides the design and conduct of the study. Objective and subjective data are collected at the individual level following a mixed-methods explanatory core design. The quantitative module, embedded in the ANRS12356 AmBASS cross-sectional survey (exhaustive sampling), is used to select a purposeful sampling of participants invited for one-on-one qualitative interviews. Additional data are collected at the institutional and community level through health facility surveys and an ethnography (in-depth interviews) of local and national CHB stakeholders. Data analysis adopts a synergistic approach to produce a multilayered analysis of individual HCPs and crosscutting analysis of the 15 health capabilities. The data integration strategy relies on a mixed-methods convergent core design, and will use 0–100 health capability scores as well as flow diagrams to measure and characterise levels of development and interactions among health capabilities, respectively.

Ethics and dissemination This study was approved by Senegalese and French authorities. Results dissemination through local workshops and scientific publications aim at fuelling effective policy change towards CHB-related health capability.

Strengths and limitations of this study

► This is the first social justice mixed-methods study to adapt the entire health capability profile (HCP) (conceptual framework) in Senegal and for chronic hepatitis B (CHB).

► This study will provide a comprehensive overview of cumulative abilities and conditions that are relevant to CHB-related morbidity and mortality in rural Senegal, and help illuminate processes for achieving optimal health capability.

► As an empirical investigation, this study has the potential to serves as a model for future adaptations of the HCP to different health issues and empirical settings using the indicative scoring table and dynamic flow diagrams presented in this paper.

► The main limitation of the study is one of external validity as results will be specific to CHB in the rural area of Niakhar in Senegal.

INTRODUCTION

Chronic hepatitis B virus infection: a 'silent epidemic' and global public health issue

With over 800 000 annual deaths worldwide attributed to cirrhosis and liver cancer secondary to chronic hepatitis B (CHB) according to 2017 WHO estimates,[1] CHB has been referred to as 'the silent epidemic' whose burden is comparable to those of HIV, tuberculosis or malaria.[2] In 2016, the WHO General Assembly committed to viral hepatitis elimination by 2030 with a three pillars strategy: prevention, testing and treatment. Primary prevention of CHB infection relies on vaccination with an efficient vaccine available since the 1990s. The vaccine is usually administered in a three doses schedule—including a birth dose in some endemic areas, and has been found to be cost-effective, including in low-income-and-middle income countries.[3] The second pillar, testing, is key to identify people who are CHB patients since CHB infection is often asymptomatic in its early stages.[4] Third, life-long monitoring is essential to know when, if ever, life-long anti-viral therapies should be prescribed to control virus replication, and avoid CHB-related complications, specifically liver damage, cirrhosis and even liver cancer.[5 6] Halfway

assessments of reaching the WHO targets of a 90% reduction in new cases and a 65% reduction in mortality by 2030 have called for global investments,[7] regional strategies[8] and a focus on countries with the greatest burden.[9]

CHB response in Senegal

CHB prevalence is the highest in the Western Pacific region (6.2%) and in Africa (6.1%).[1] Senegal was the first country in the sub-Saharan African region to set up a National Viral Hepatitis Programme in 1998. In this country, an estimated 8%–10% of the population currently lives with CHB.[10] Hepatitis B vaccination was introduced in the expanded programme on immunisation starting in 2004 through the three dose pentavalent vaccine, with the addition of an extra dose within 24 hours of birth since 2016. Non-institutional stakeholders include the 'Saafara Hépatites' patients association and the gastroenterology and hepatology Senegalese society (SOSEGH) that gathers medical experts. Antiviral therapies that can control viral replication (but do not cure from chronic infection) are offered at a subsidised monthly price of 5000 CFA (about US$8), and in 2018 the Ministry of Health together with the National Viral Hepatitis Programme announced the decentralisation of CHB care to regional hospitals and reference healthcare facilities at the district level.[11]

Despite the country's early response, the mobilisation of civil society, and the existence of both preventative and curative options, Senegal is one of the only African countries to have seen an increase in estimated CHB prevalence between the late 1950s and the early 2000s.[12] Nowadays, liver disease secondary to viral hepatitis remains one of the leading cause of cancer,[13] particularly among adult Senegalese men and women who were born before the successful implementation of the vaccination programme.[14]

Standard approaches to CHB-related morbidity and mortality in sub-Saharan Africa, and in Senegal

Most studies conducted in sub-Saharan Africa have focused on the role of health services organisation and delivery and identified long waiting times,[15] delays in administration of the birth dose,[16 17] opportunistic rather than systematic vaccination[18] or insufficient screening[19] as major barriers to reaching the WHO target of CHB elimination by 2030.[8] Individual factors associated with CHB infection in sub-Saharan Africa include demographic characteristics such as age, gender or education level,[20–22] customs, specifically home delivery, scarifications/tattooing, circumcision or shared items,[23 24] and medical history of surgery, injectable medication or family history of liver disease.[25 26]

In Senegal, previous studies have particularly highlighted limited hepatitis B-related knowledge, both among lay population[27] and healthcare workers, from nurses in local dispensaries[28] all the way to physicians working in Dakar hospitals.[29] Factors related to health services organisation and delivery, such as the fact that

Table 1	The health capability profile[37]
Health capabilities	

Internal	External
► Health status and health functioning (2)	► Social norms (6)
► Health knowledge (4)	► Social networks and social capital for achieving positive health outcomes (3)
► Health-seeking skills and beliefs, self-efficacy (3)	
► Health values and goals (4)	► Group membership influences
► Self-governance and self-management and perceived self-governance and management to achieve health outcomes (5)	► Material circumstances (6)
	► Economic, political and social security
	► Utilisation and access to health services (5)
► Effective health decision-making (4)	► Enabling public health and healthcare systems (3)
► Intrinsic motivation	
► Positive expectations	

Each health capability comprises one or several (number in parenthesis) domains.

CHB testing and bi-annual follow-up examinations remain costly (up to US$75 for the latter) and are rarely available at local healthcare facilities, have also been documented as potential obstacles to CHB prevention and linkage-to-care in Senegal.[30]

Finally, societal factors such as stigma attached to CHB infection and discrimination of CHB patients have long been a blind spot of studies conducted in the African region.[31] To the best of our knowledge, it remains undocumented in Senegal despite recent evidence in Ghana,[32 33] Zambia,[34] Uganda[35] or Cameroon.[36]

Health capability profile: a multi-dimensional and in-depth framework

Compartmentalising these factors and focusing on individual or social indicators in an ad hoc and fragmented manner, fails to provide a full picture of what dynamically plays into people's ability to avoid CHB-related morbidity and mortality in their complex lived experiences. A thorough investigation requires a more comprehensive, multi-dimensional and in-depth framework, such as the HCP.[37]

The HCP identifies eight individual abilities (internal health capabilities) and seven societal abilities or conditions (external health capabilities), that interact with each other and together create people's ability to effectively achieve optimal health given one's biological predispositions, one's cultural and socioeconomic environment, and available healthcare services and public health infrastructure[37] (see table 1).

The HCP generates an understanding of the integrative and multi-dimensional experience for individual health conditions, risk factors and health-related behaviours, the individual abilities of self-efficacy, perception, knowledge or motivation, and societal conditions—including, but

not limited to, social norms, social networks, and material circumstances.

The HCP recognises important advances of the biomedical model of disease,[38] health belief models[39 40] and social determinants of health.[41–44] However, compared with these alternative frameworks, the HCP builds on the basic idea that manifestations of diseases are the result of cumulative interactions of various capabilities. The profile is a dynamic framework that examines the combination, inter-relatedness and interdependence of internal (individual) and external (societal and environmental) health capabilities in relation to risk of diseases, and resilience towards health and wellness.

Another attractive feature of the HCP is that it focuses on the identification of gaps between observed health capabilities, and an optimal level of health capability. It therefore contributes to the emerging field of implementation science,[45–47] which seeks to ensure that evidence-based research (here, optimal health capabilities) translate into practice (observed health capabilities).

Finally, but not least, the HCP contains a normative dimension. Drawing from the concept of human flourishing, the health capability paradigm reasons that individuals and societies work together towards the reduction of escapable morbidity and premature mortality—central health capabilities.[48] It advances normative principles on how to intervene to improve individual HCPs—tracking this overtime with the aim of moving from risk to resilience, individual and collective.[48] The HCP can hence provide powerful guidance for health policy design and evaluation.

OBJECTIVES
The overall objective of this study is to study CHB-related morbidity and mortality in rural Senegal using the HCP.

Secondary objectives
The secondary objectives are twofold. First, there is a methodological aspect, which is to adapt the HCP in order to investigate a contextualised public health issue, specifically CHB in rural Senegal.

Secondary objectives are also of an empirical nature:

1. To quantify and characterise gaps between observed and optimal health capabilities relevant to CHB in rural Senegal, and document interactions among these health capabilities.
2. To distinguish strengths and vulnerabilities that are peculiar to CHB patients, in particular in relation to entry into, and retention in CHB care. This includes an anthropological perspective to account for cultural and social aspects that are at play in rural Senegal.
3. To identify marginalised CHB-related health capabilities (at the community level) and marginalised individual HCPs, and investigate positive examples of advanced levels of development of CHB-related health capabilities.

4. To draw from the profile to help inform and prioritise short-term and long-term policy change towards the elimination of CHB-related morbidity and mortality, or in other words, towards CHB-related health capability for all people living in rural Senegal.

METHODS/DESIGN
Study setting
The study takes place in the Niakhar Health and Demographic Survey System[49] (HDSS), in Senegal, a rural area located 135 km east of the capital, Dakar. The HDSS covers 30 villages, home of over 45 000 inhabitants (2018 census), which has been under demographic surveillance since 1962. Mortality tables and immunisation records are available for all residents. The Niakhar HDSS, situated in the middle of the Fatick region, has a long history with the Senegalese hepatitis B response. Between 1978 and 1981, the area hosted one of the first hepatitis B vaccine trials conducted in Africa,[50] and in July 2018, the Fatick region was appointed a pilot region for the decentralisation of CHB care by the Senegalese National Viral Hepatitis Programme.[11] More recently, the ANRS 12356 AmBASS survey on the burden of CHB took place between October 2018 and July 2019 in the Niakhar HDSS. Three hundred households were randomly selected, and all residents over 6 months of age were invited to participate to hepatitis B home testing, and to be interviewed using standardised face-to-face questionnaires.[51] In a second step, participants who tested positive to CHB undertook further exams to assess the stage of their disease, and treatment was provided to those eligible. In total 3118 participants representative of the Niakhar HDSS population were recruited, among which 1505 were born before September 2003 (hereafter adults), and 206 tested positive for CHB (a 7.1% CHB prevalence in the general population; 12.6% in the adult population).[52]

Adaptation of the conceptual framework
The HCP's general framework was comprehensively adapted to the context of the empirical study, specifically CHB in rural Senegal (see box 1). First, the profile focuses on information relevant to CHB infection in the Niakhar area including hepatitis B transmission routes—blood and sexual fluids—, the natural history of the disease as well as risk factors and behaviours, in particular alcohol use, a main factor associated with liver fibrosis in Western Africa[53] as is peanut consumption,[54] the Niakhar area's main cash crop. Prevention of CHB-related morbidity and mortality is also at the heart of the adapted profile through a focus on knowledge on, access to, and utilisation of hepatitis B testing and vaccination, CHB care and anti-viral treatment options.

Second, the profile expresses elements of rural Senegal and the Niakhar HDSS, such as social norms in relation to the cultural and religious beliefs of the population of Serer ethnic group and majority Muslim[49] or the importance of traditional medicine.[27] Similarly, social

Box 1 Adaptation of the health capability profile to chronic hepatitis B (CHB) in rural Senegal

Health status and health functioning
1. Self-reported health status.
2. Health conditions: CHB-related health conditions (CHB status, and disease evolution if applicable; hepatitis B vaccination status; risk factors, including alcohol use, etc) and other health conditions.

Health knowledge
1. Knowledge on one's own hepatitis B and vaccination status.
2. Knowledge on hepatitis B transmission routes, disease evolution, vaccination, testing and treatment.
3. Knowledge on behaviours that are CHB risk factors (alcohol use, nutrition, obesity).
4. Modes of health and CHB information gathering: healthcare providers, internet, newspapers, radio, patients' associations, traditional healers, etc.

Health seeking skills and beliefs, self-efficacy
1. Belief in one's ability to avoid hepatitis B infection, or transmission and CHB-related complications.
2. Ability to acquire CHB-related skills, and apply them: learning to monitor CHB condition and avoid infection or transmission (vaccine, hygiene, etc).
3. Confidence in ability to perform or abstain from CHB-related health behaviours such as avoiding alcohol use, adapting diet, etc.

Health value and goals
1. Valuing one's health in general.
2. Valuing the prevention of hepatitis B infection and transmission or CHB-related complications.
3. Valuing CHB-related lifestyle or behaviours: change in diet (including alcohol use), hygiene, etc.
4. Recognising and countering social norms detrimental to CHB prevention and monitoring.

Self-governance and self-management and perceived self-governance and management to achieve health outcomes
1. Ability to be in control of one's life, to set and reach objectives in general.
2. Ability to handle one's workload within the extended household (children, household work, farming, etc) and outside (job or studies, etc).
3. Ability to control one's behaviours for health or CHB-related purposes, for example, avoiding peanuts-rich family meals or situations that involve alcohol.
4. Ability to seek out support (help from family, neighbours) and obtain resources (transportation, financial means, etc) to access CHB-related care.

Effective health decision-making
1. Ability to use CHB-related knowledge and available resources to avoid infection, transmission or disease evolution.
2. Ability to weigh the short-term and long-term costs and benefits of CHB-related behaviours and actions, including alcohol use.
3. Ability to identify CHB-related symptoms (in particular jaundice) and pursue vaccination, testing, follow-up and/or treatment.
4. Ability to make healthy choices in relation to CHB: reducing alcohol consumption, not sharing hygiene equipment, etc.

Intrinsic motivation to achieve desirable health outcomes
Quantifying motivation to avoid hepatitis B infection, transmission or CHB-related complications, and exploring whether it is internally (personal assessment) or externally (eg, pressure from relatives or healthcare providers) motivated.

Positive expectations about achieving health outcomes

Continued

Box 1 Continued

Optimistic or pessimistic viewpoint on personal life and CHB-related health prospects (avoiding infection, transmission and/or complications).

Social norms
1. Social norms on hepatitis B in relation to national and international recommendations.
2. Favourable or unfavourable views on hepatitis B vaccination, on people living with CHB, alcohol use and condom use.
3. Quantification and characterisation of people that undertake CHB vaccination and testing or adapt diet (including reducing alcohol consumption).
4. Discrimination or antidiscrimination of people living with CHB and of people seeking to access prevention or care (eg, people with alcohol use disorder).
5. Norms on decisional latitude or power in relation to health in general, and CHB in particular.
6. Changes and resistance to social norms relevant to CHB (eg, vaccination, alcohol use, healthcare access).

Social network and social capital
1. Ability to ask for instrumental help (eg, delegating tasks for CHB care purposes), and ability to talk about one's problems including CHB status.
2. Existence of patients' association, or other groups/networks that can support and provide information to people in relation to CHB.
3. Existence of social networks or groups of people that have a detrimental impact in relation to CHB (discriminatory practices, false information, etc).

Group membership influences
Membership to any kind of community organisation (union or political party, sports team, association, etc), or informal group that may provide instrumental or emotional support, or counterbalance/augment social norms relevant to CHB.

Material circumstances
1. Economic activity (formal or informal, part or full-time) and monetary resources.
2. Neighbourhood's quality of life and resources including access to healthcare facilities.
3. Water source, waste management and latrines system.
4. Housing status and quality (in particular crowding and heat protection).
5. Availability and quality of food (specifically dependency on peanuts).
6. Other CHB patients and other sources of pollution or disease in the immediate environment (soil, air, malaria, etc).

Economic, political and social security
1. Economic security: availability, quality and security of jobs (temporary vs permanent, wage, unemployment protection and insurance, sick leaves).
2. Political security: existence of institutions (including the judiciary) and elected representatives that represent the people's interests, and prevent violence and criminal activity.
3. Social security: existence and quality of financial, old age, or disability protection schemes (eg, pensions, access to bank accounts).

Utilisation and access to health services
1. Symptoms of CHB-related health issue (jaundice, advanced liver disease).
2. Other serious or morbid symptoms of poor health.
3. Perception of a need to see a healthcare provider (vs traditional medicine or none).
4. Existence of CHB-related health services: availability of vaccination, testing, CHB follow-up examinations and consultation.

Continued

Box 1   Continued

5. Barriers to access: geographic accessibility, waiting times, costs, etc.

Enabling public health and healthcare systems

Extent to which healthcare facilities and health authorities (ministry representatives, healthcare professionals and facilities) are doing the following:

1. Giving information and helping people take charge of CHB prevention and monitoring.
2. Helping protect people from CHB infection, transmission and complications.
3. Being efficient in providing CHB-related care, and being accountable if not.

capital and networks emphasise informal neighbourhood groups, extended households, weekly markets, going to the mosque and membership in football teams, whereas material circumstances account for the area's hot weather, unpaved roads, informal work and seasonal work migration.[55] In particular, the profile will capture the impact of geographic mobility (in terms of knowledge, economic capacity, etc), and its relationship with the sociocultural construction of the aetiology of hepatitis B as well as with possible treatment routes (in Niakhar and elsewhere).

Additionally, the profile appeals to all stakeholders involved in CHB care and policy in Senegal, both the national level (such as the Viral Hepatitis Programme, the Ministry of Health, the Society of Senegalese Hepatologists and Gastroenterologists, the Saafara Hépatites Patients Association, etc), and at the local level—specifically community-based healthcare workers (*bajenu gox*), healthcare providers and the centre of traditional healers.

Study design

This ongoing study follows a sequential social justice mixed-methods design (see figure 1) in that the HCP guides the design and conduct of the research.[56 57] A full understanding of the various health capabilities and the overall health capability of a person requires data on objective abilities and situations (eg, CHB status, CHB knowledge, economic circumstances, etc), as well as information on subjective experiences (including, but not limited to, perceived competency, motivation, expectations, group membership influences, perception of a need to seek health services, etc). The need for objective and subjective quantitative and qualitative data from the individual and institutional and community perspectives necessitates a mixed-methods design that combines quantitative and qualitative data collection.

The first step of the study relies on an explanatory core design[57 58] with individual level quantitative data collection followed by qualitative data collection in the form of individual interviews. The quantitative survey provides an overview of gaps and optima in health capabilities associated CHB-morbidity and mortality in the study area (objective data) and is used for the purposeful sampling of participants invited for qualitative interviews. The subsequent qualitative data collection (essentially from an anthropological perspective) helps refine and complete these results with in-depth, dynamic and comprehensive HCPs, including information on personal experiences
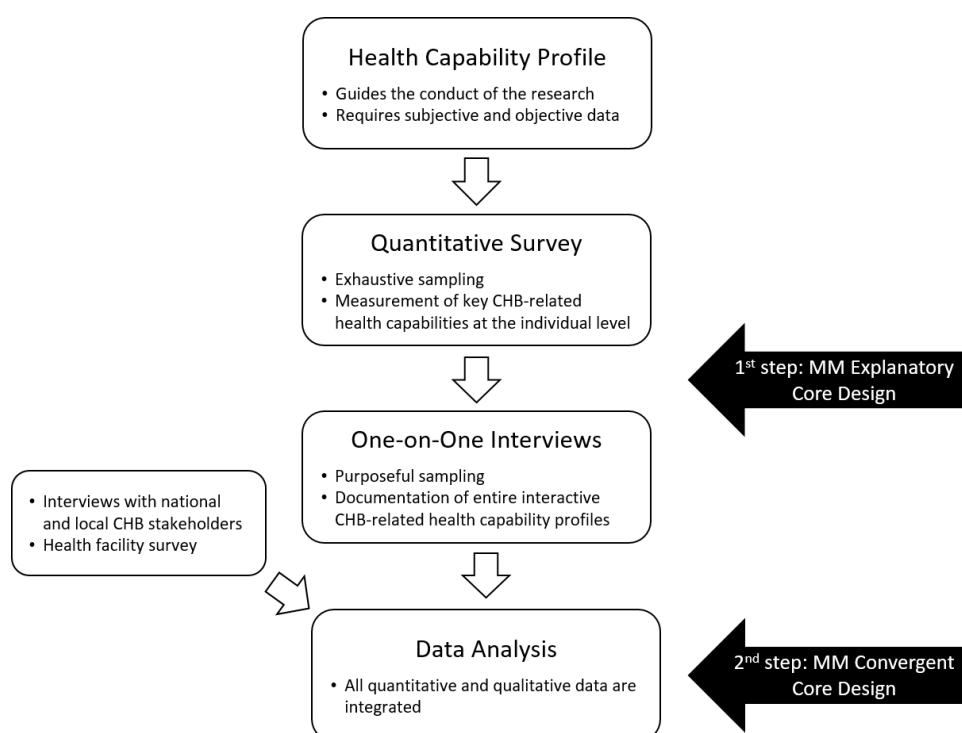

Figure 1 Sequential social justice MM study design. CHB, chronic hepatitis B; MM, mixed-methods.

(subjective data) as well as interactions between health capabilities at the individual level, both of which cannot be properly documented with standardised questionnaires. In contrast, in-depth one-on-one interviews are particularly appropriate to gather perceptions and representations of CHB-related health behaviours, beliefs and obstacles to entry into care.

In addition, all stakeholders and elements of the Profile need to be accounted for. This includes individuals, healthcare system and healthcare professionals, institutional representatives, patients' advocates, etc. We therefore complement individual level data collection with institutional and community-based data collection through a health facility survey of CHB resources in the healthcare system and in-depth interviews with national and local CHB stakeholders. Whenever possible, these interviews take place as focus groups in order to confront point of views and thereby identify convergence and divergence on health capability development, in particular among representative of local healthcare workers or community leaders. It is likely that national stakeholders will be involved through one-to-one interviews, which are more flexible in terms of accommodating busy schedules.

In a second step, information from interviews (qualitative data) and from individual and health facility surveys (quantitative data) are all integrated following a mixed-methods convergent core design.[57]

The quantitative survey took place between January and July 2019. The subsequent conduct of the one-on-one interviews, focus groups and health facility survey was significantly delayed by the COVID-19 epidemics; it eventually started in July 2021 and is expected to be completed by the end of March 2022.

Quantitative survey

A specific module was designed based on the HCP, in conjunction with a review of empirical studies, to identify items that could document health capability domains given the study area and participants. Health status and health functioning is assessed using self-reported health (SF12v2 health survey[59]), CHB status and body mass index in all participants; in addition a clinical and biological check-up (to identify liver disease stage) and CHB-risk factors are explored for participants who tested positive for CHB. Health-related knowledge is documented through general knowledge on CHB including transmission routes, clinical complications, hepatitis B vaccine and knowledge of hepatitis B testing. Health seeking skills and beliefs, and self-efficacy are measured with questions on perceived health competency.[60] Self-governance and self-management and perceived self-governance and management to achieve health outcomes is evaluated through a 10 step hypothetical ladder measuring individual-level perception of empowerment.[61] Intrinsic motivation to achieve desirable health outcomes is assessed using an adaptation of the relative autonomy index[62] and social norms are measured at the individual level through last say type of questions on individual decisional latitude.[63]

Data on material circumstances include the household's economic status and monetary resources, type of neighbourhood, water access, housing and living conditions, food security, and the CHB status of the other household members. Finally, access and utilisation of health services is documented using symptoms of poor health, healthcare utilisation and obstacles to healthcare seeking.[64] The quantitative health capability module was embedded in the demographic and socio-economic quantitative data collection of the 12356 ANRS AmBASS survey[51] (see the survey in online supplemental appendix 1) and administered to all 725 adult participants included after January 2019. This sample allows for a 3% margin of error with a 95% confidence level, given an upper limit of a 15% prevalence of CHB patients among the 25 000 inhabitants over 15 years of age in the Niakhar area (533 individuals required). Trained interviewers recorded answers using tablets equipped with the VoxCo software.

One-on-one interviews

All health capabilities of the profile were clarified, expressed in the context of rural Senegal, translated into French (official language of Senegal) and reworded as an open-ended question that is accessible and meaningful to all study participants in order to build the interview guide. For example, the internal factor's dimension on enabling healthcare and public health systems will be investigated through the question, 'What is your perception on the work the healthcare facilities and health authorities (ministry representatives, physicians, dispensaries, health center, regional hospital and hospitals in Dakar) are doing in helping you taking care of your health, including when it comes to hepatitis B?'. The interview guide also includes an extensive list of clarification questions meant to guide interviewers in covering all 49 domains comprised in the profile (see figure 2 for an example, and online supplemental appendix for the whole discussion guide).

The preliminary interview guide was discussed, clarified and translated in Wolof and Serer during pilot interviews conducted with the participation of members of the Safaraa hepatitis patients' association. One-on-one semi-structured interviews are recorded and conducted in Serer (local language of the main ethnic group), Wolof (spoken by a majority of the Senegalese population) or French according to the participant's own preference. Recordings are erased after transliteration, and translation—for interviews conducted in Wolof and Serer—by the research team.

The selection of the AmBASS survey participants invited for a one-on-one semi-structured interview follows a purposeful sampling strategy, first, in order to interview individuals that represent the population's diversity in terms of age, gender, education level, occupation, CHB status and healthcare utilisation, and second, to represent the population's diversity in terms of CHB-HCP and health capability capital. Participants are contacted for interviews using these criteria, until data saturation
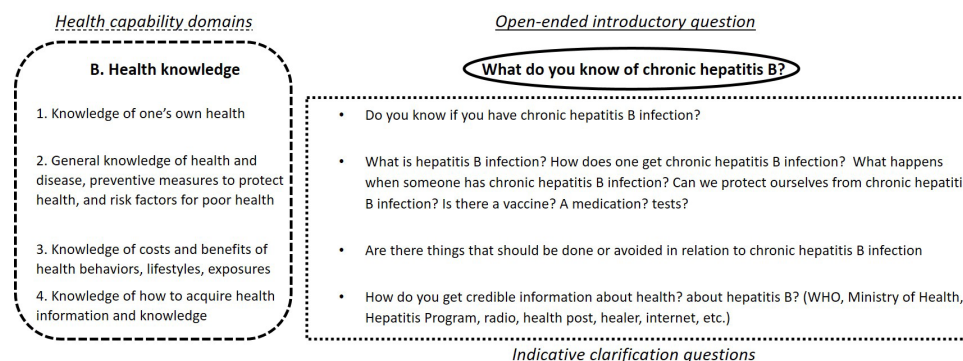
Figure 2 Illustration of the English version of the full interview guide using the internal health capability n°2, health knowledge.

is reached—it is expected to happen at around 35–40 in-depth individual interviews.[65]

Interviews with local CHB stakeholders

Additional interviews are conducted with healthcare staff involved with hepatitis B prevention or care for patients living in the Niakhar area, community health counsellors (*bajenu gox*) of the Niakhar area, members of the Saafara hepatitis patients' association, and institutional stakeholders involved in CHB policy (Viral Hepatitis Programme, Ministry of Health, etc) to complement information on CHB-related external health capabilities. More specifically, these interviews are used to collect objective, community level data on CHB-related social and cultural norms, social networks and group membership influences, the political, economic and social security and the availability, safety, efficiency and accountability of health services, and of the overall healthcare system (including health and cultural beliefs and behaviours). These additional interviews are ongoing and will be conducted until all types of stakeholders are represented, and after data saturation has been reached—which should happen at around 2–3 focus groups or 10–15 one-on-one key-informant interviews. The discussion guide is presented in online supplemental appendix.

Health facilities survey

The survey makes an inventory of resources available in all the health facilities involved with CHB patients living in the Niakhar area: the public dispensaries of Diohine, Ngayokheme and Toucar, the Diohine private dispensary, the Niakhar and Fatick health centres, the Fatick regional hospital and the Dakar reference hospitals for advanced liver disease secondary to CHB (exhaustive sampling). The survey draws from a micro-costing methodology to document the availability and use of resources mobilised or mobilisable for CHB care, specifically human resources (headcount, general as well as specific CHB training, workload and salary base of physicians, healthcare workers and administrative staff), equipment and facilities, medical imaging, biological examinations (laboratory facility, staff and machinery) and medication. The health facility questionnaire is presented in online supplemental appendix.

DATA ANALYSIS PLAN AND DATA INTEGRATION STRATEGY
Multi-layered, synergistic data analysis plan

The data analysis plan is multilayered. The first layer is the individual level through the documentation of individual HCPs. The second layer of analysis will consist in a crosscutting analysis of each of the 15 health capabilities conducted at the level of the Niakhar area. The data analysis plan also draws from a synergistic approach[66] in adopting a position of equal value of qualitative and quantitative data, and aiming at producing robust qualitative, quantitative and mixed-methods results (see figure 3).

First, we will use data from the quantitative survey to produce descriptive statistics for each of the health capability domains that are documented in the survey (health status, knowledge, perceived competency, intrinsic motivation, social norms on decisional latitudes, material conditions, healthcare access and utilisation), either complete (participants to the quantitative survey and one-on-one interviews) or incomplete (participants to the quantitative survey only). Outcomes of the quantitative data analysis are the identification and quantification of gaps (eg, low hepatitis B knowledge) or optima (eg, high self-reported health) in those key health capabilities in the general population of the Niakhar HDSS.

Second, the qualitative data analysis will rely on deductive content analysis using the 15 health capabilities and
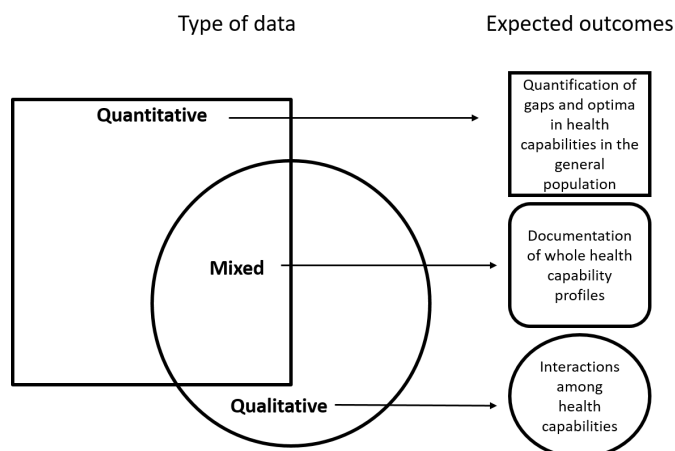

Figure 3 Illustration of the synergistic approach: type of data and expected study outcomes.

Table 2 Indicative health capability development scoring table

Score	Stage of capability development	Internal capability 'The individual is …'	External capability 'The conditions are …'
0	Absence/Nil	Naive	Unpropitious
10	Basic 1	Novice	Non-hindering
25	Basic 2	Advance beginner	Promising
40	Intermediate 1	Autonomous	Propitious
55	Intermediate 2	Competent	Favourable
70	Advanced 1	Experienced	Facilitating
85	Advanced 2	Proficient	Enabling
100	Optimal	Expert	Fully enabling

their domains as a coding matrix to analyse the transcription of the interviews and focus groups.[65 67] Qualitative data will reveal interactions among health capabilities, as well as community-level health capabilities' dynamics and levels of development. This analysis will include the additional information from interviews with national and local CHB stakeholders as well as objective data from the health facility survey.

Finally, quantitative and qualitative data will follow a process of data integration to produce a mixed-methods analysis of whole HCPs at the individual level in participants to both the quantitative survey and one-on-one interviews. The data integration strategy will rely on the use of health capability scores and flow diagrams; both these tools were developed as part of this study.

Health capability scores
First, individual-level qualitative and quantitative data will be combined to yield a 0–100 score for each of the 15 health capabilities. Some quantitative data such as Likert-scale type numeric variables can be directly turned into such a score. Other data will be transformed using an indicative scoring table (see table 2) developed from the Dreyfus model of skill acquisition and its adaptation to clinical competence,[68] and the community readiness model.[69] The 100 maximum score, or optimal level, corresponds to a normative but realistic and attainable goal that accounts for the context, both at the macro and individual levels. For internal capabilities, optimality corresponds to the level of expertise that can be attained by a layperson, for instance in individuals involved in delivering expert patient programmes.[70–72]

Two team members trained to the HCP will independently score profiles, with a third member solicited for scores diverging by more than 15 (ie, a whole stage of development). Scores will be employing the whole 0–100 range. (For example, the four questions on self-perceived competency with a 5-point Likert scale will be aggregated employing a new scale of value 0 (fully disagree)/5 (disagree)/10 (neither agree nor disagree)/20 (agree)/25 (fully agree) allowing for all levels of developments ranging from someone fully disagreeing will all four items (score 0) to someone fully agreeing with them (scoring 100), an optimal but attainable level of perceived competency.)

Health capability scores will then be aggregated across individuals for each of the 15 health capabilities in order to document areas of shared strengths or vulnerability that can help inform and prioritise policy. Scores will be also be aggregated at the individual level to quantify overall level of health capability development (overall health capability set), which should allow for the identification and characterisation of profiles at each end of the health capability set (ie, strong vs vulnerable profiles). Strong profiles will be used to comprehend the dynamics behind positive examples of advanced levels of development of CHB-related health capabilities, whereas marginalised health capability domains or profiles shall help guide policy change towards the greatest needs. However, these aggregated scores complement, but do not replace, the detailed analysis of health capabilities: the profile as a whole is what creates health capability.

Dynamic flow diagrams
Flow diagrams will also be used to integrate quantitative and qualitative data at the individual level (see a hypothetical example in figure 4).

These diagrams help place the most relevant health capabilities on a nil to optimal development continuum, and reveal interactions between health capabilities, including cumulative building (eg, virtuous circles or vicious circles).

Patient and public involvement
CHB patients were represented through the Saafara Hepatitis patients' association, which participated in the study design workshop and data collection training session. CHB patients, the Saafara Hepatitis patients' association, healthcare professionals, SOSEGH members and institutional stakeholders are all involved in the study through group or one-on-one interviews. They will also be invited to result dissemination workshops organised at the local (Niakhar area) regional and national levels.

Ethics and dissemination
Ethical considerations
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
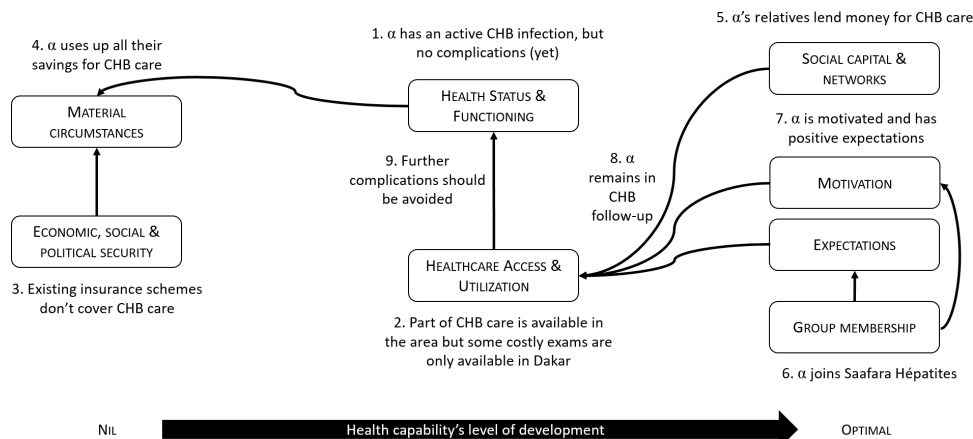
Figure 4 Flow diagram of α's hypothetical case On participating to the AmBASS study, α was tested positive for CHB, and the examinations showed that the infection is active (1). International and national CHB care guidelines recommend a biannual follow-up, including a consultation at the local dispensary as well as a viral load and Fibroscan imagery, which are only available in Dakar, and at a non-negligible cost (2). α's community-based health insurance does not cover any of these costs (3). α uses all the household's savings (4) and further borrows from relatives (5). α also joined the Saafara Hépatites patients' association (6), which helps α remain motivated, and have positive expectations (7). α manages to be followed up for CHB care (8), which should help prevent further complications (9). CHB, chronic hepatitis B.

authorisation from the French Commission on Information Technology and Liberties (CNIL) reference MMS/HG/OTB/AR181521.

Information, consent and data confidentiality

All participants were explained the design and objectives of the study and signed two copies of the informed consent form before the start of the quantitative data collection. The procedure and objectives of the qualitative data collection are also presented to participants invited for semi-directed interviews who will sign two copies of a separate inform consent form. Participants are identified using a unique, study-specific identification number (ID) that was entered in the electronic tablets during the face-to-face questionnaires (quantitative data collection). This study ID is also used to connect quantitative and qualitative data. Information that could identify participants or their relatives (such as individual names,

addresses or neighbourhoods) are removed during the transcription of one-on-one interviews, and recordings are erased directly after transcription. The team members in charge of data analysis therefore only have access to pseudonymous data.

Expected benefits and risks for study participants

The main risk for participants in the AmBASS survey was to learn of one's CHB status; in contrast, they benefited from free CHB-related care, specifically testing, the initial clinical examination and biological check-up, consultation in reference facilities and provision of antiviral therapy until the end of the study funding (March 2022). The study also collaborated with the Sen-B research cohort at the Fann Hospital in Dakar to offer participation for AmbASS active CHB patients, which comes with fully funded CHB care for the duration of the cohort. Participation in the qualitative data collection does not entail
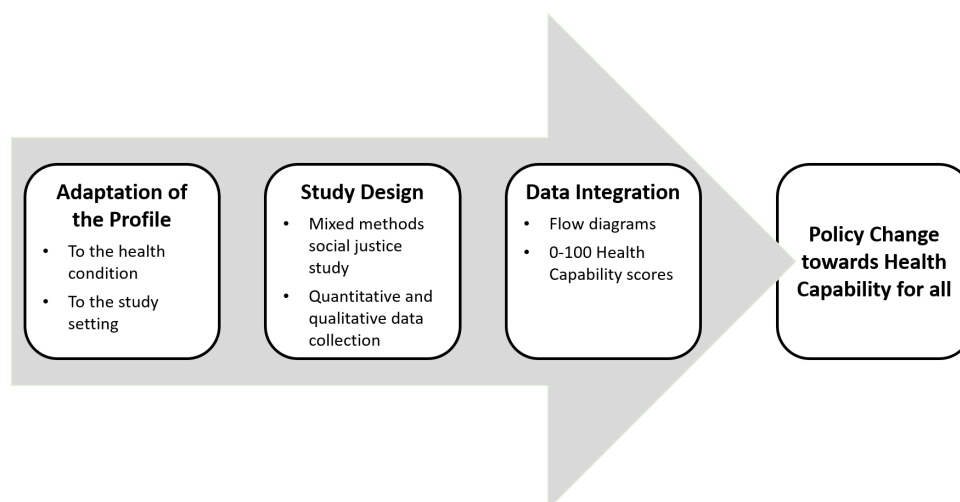

Figure 5 Applying the health capability profile.

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any risks, apart from the time dedicated to the interview. All participants will benefit from results dissemination, as well information and sensitisation on prevention of CHB-related morbidity and mortality.

Expected results and dissemination plan
Empirical application of the HCP
Using a social justice mixed-methods sequential design, this study adapts the HCP to empirically study CHB-related morbidity and mortality in rural Senegal. To our knowledge, this is the first time to collect in one study and for each individual both individual factors such as knowledge, perceived competency and motivation as well as social (external) factors such as social norms, type of neighbourhood, social networks or living conditions, all linked to health status and health outcomes in relation to CHB. In line with recent calls for dynamic and multidimensional approaches to social conditions and factors that influence people's health,[73] the HCP will capture a broader, multidimensional and more accurate array of interrelated factors that puts individuals at risk or to be resilient for CHB and successful CHB prevention and/or management in rural Senegal.

The overlapping and interactive nature of the profile entails that a number of data/information will be analysed in several health capabilities. For instance, an absence of health insurance will inform a shortfall in overall social security as well as a potential obstacle to accessing health services. Similarly, CHB-related symptoms document both health status and functioning, and the perception of the need to see a health provider when experiencing a serious or morbid health symptom, which is part of utilisation and access to healthcare services. To address potential concerns of duplicates at the health capability level, we primarily assign quantitative indicators to a preferred health capability (as showed in quantitative survey's structure presented in online supplemental appendix), combine several quantitative indicators for each health capability, and integrate them with qualitative data to establish final scores. We would also control for collinearity if introducing several health capabilities scores in a regression (though it is not the focus of our analysis). Far from problematic, we believe that it is a strength of the profile to account for, and emphasise, the inter-relatedness among individual skills and features, and broader conditions.

In addition, the HCP relates to the concept of positive deviance, which has been used to highlight positive, intentional departure from standard medical practice,[74] with recent applications to the prevention and control of infections[75] or to health equity issues[76] beyond the realm of healthcare and public health systems. The HCP allows for the identification of effective or positive examples in all domains that constitute a person's health capability (including in areas such as health-related knowledge, beliefs, motivation or expectations).

Furthermore, unlike perspectives that focus solely on individual abilities and characteristics, the profile brings out collective capabilities from a sociological and anthropological point of view. For instance, the profile will document the interplay between gender-specific decision-making latitude, financial agency, healthcare seeking expectations and behaviours, and geographic mobility relevant to women, or reveal interactions or health capability strengths and shortfalls that are at play in marginalised populations.

For these reasons, the HCP will help better illuminate the most important or most influential factors or interactions of factors in the system of health production or disease creation in relation to CHB for actionable recommendations in rural Senegal, and other relevant settings.

Finally, as an empirical investigation, our study serves as a model for future adaptations (see figure 5). While the HCP has been applied in other settings and populations,[77 78] this is the first empirical mixed-methods study to adapt the entire HCP in Senegal and for CHB. Applications to different research questions, settings or populations, will be able to draw from our study design, data collection tools, synergistic approach to quantitative, qualitative, and mixed data analysis, and data integration strategy using capability scores and flow diagrams.

Our study presents a clear strategy for mixed-methods data integration, with the use of individual flow diagrams and of a 0–100 score for each of the 15 health capabilities derived from a detailed indicative scoring table. The provision of eight distinct levels of health capability development with corresponding descriptions for internal and external capabilities produces a refined model which should allow overcoming most of the challenges associated with data integration in mixed-methods studies.[79] Our approach thereby contributes to the literature on data integration strategies[80] and provides a response to the lack of coherence which has been noted in a recent review of applications of the capability approach to the health field.[81]

RESULTS DISSEMINATION
Results dissemination workshops will be organised at the local (Niakhar area) regional and national levels. As per the social justice orientation of this study,[56] results dissemination will aim at building on the study results to fuel discussions, actions plans and effective policy change towards HBV-related health capability for all. Results will also be disseminated through publications in scientific peer-reviewed journals, and presentations in international conferences on viral infections including hepatitis, public health, social sciences, etc.

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