transmitted by exposure to infected blood and other body fluids such as semen and vaginal fluid[3]. Most morbidity from HBV is due to chronic infection. An estimated 240 million people are infected with HBV worldwide, and more than 686,000 deaths are attributable to chronic HBV complications annually[2,4,5]. The likelihood of developing chronic HBV is highest if infection occurs at time of birth, and approximately 70–90% of persons infected perinatally progress to develop chronic HBV infection[3,6,7].

With only 16% of the world's population, countries in the World Health Organization's (WHO) African Region are disproportionally affected, and have the highest endemicity worldwide (8.83%, defined as having a chronic hepatitis B surface antigen (HBsAg) population prevalence of ≥8%[8,9]. Despite the availability of an effective vaccine, approximately 5–10% of the adult population is chronically infected and chronic HBV is a leading cause of death for young adults in the region, most of who are unaware of their infection until the disease has progressed to late stages[2,10,11]. In highly endemic settings, HBV is mainly transmitted perinatally from mother-to-child at the time of birth, and through horizontal transmission during early childhood[12]. WHO recommends universal vaccination with a monovalent dose of hepatitis B (HepB) vaccine (HepB-BD) given within 24 hours of birth, followed by at least two subsequent doses[3]. Vaccination has been shown to dramatically reduce the post-vaccination prevalence of HBsAg carriage in children less than 5 years[13]. Timely HepB-BD (given within 24 hours after birth), followed by at least two doses is 90% effective at preventing perinatal transmission[3,7].

All African countries have incorporated HepB vaccine in their Expanded Programme for Immunization (EPI) schedules. The vaccine is usually given as three doses of the pentavalent vaccine (diphtheria, tetanus, pertussis, Haemophilus influenza type B, and HepB) at 6, 10, and 14 weeks of age[11]. Regional coverage for the third dose of HepB (HepB3) has increased from 5% in 2001 to 76% in 2015; however, this is below the global coverage of 84%[14]. Individual country estimates range from 16% in Equatorial Guinea to 98% in Rwanda, Seychelles, Swaziland and the United Republic of Tanzania, with significant variation at district level. African countries have been slow to implement a 2009 WHO recommendation to introduce HepB-BD, and so far only 23% of children in the region are benefiting from the vaccine[15]. These children reside in 11 countries that have introduced HepB-BD (Algeria, Angola, Botswana, Cape Verde, the Gambia, Mauritania, Mauritius, Namibia, Nigeria, São Tomé and Príncipe [STP], and Senegal)[14]. In November 2014, during the Sixty-fourth session of the Regional Committee, the African Region adopted a resolution to reduce chronic HBV infection to less than 2% in children under 5 years of age, and to introduce HepB-BD in at least 25 countries by the end of 2020[16].

Timely HepB-BD implementation poses programmatic challenges which should be considered prior to its introduction[17,18]. Even the Gambia which was one of the first countries to introduce HepB-BD, is reaching less than 3% of newborns with timely HepB-BD[19,20]. Multiple factors have been documented to affect implementation of HepB-BD[21–23]. Of these, human resource factors e.g., staff shortages, lack of training opportunities, poor attitude and gaps in knowledge among healthcare staff are frequently associated with poor uptake of immunization programs in Africa[24,25]. The effect of healthcare workers (HCWs) is especially important when it comes to implementing HepB-BD given the timing recommendations of the vaccine.

With the recent resolution to increase timely HepB-BD coverage in the region, is important to first understand the experiences from the few countries that have already introduced HepB-BD. This will help guide other countries who are in the process of operationalizing HepB-BD or seeking to strengthen existing programmes. This paper presents findings from assessments conducted to determine the level of knowledge, attitudes, and practices surrounding HepB-BD administration among HCWs in five African countries.

Methods

Between August 2015 and November 2016, cross-sectional studies were carried out in select administrative regions in Botswana, the Gambia, Namibia, Nigeria and STP (Figure 1). The regions were selected based on the previous years' reported HepB-BD coverage and identification as a priority area by EPI staff based on low immunization system performance as indicated by coverage with three doses of DTP (DTP3) vaccine. Within each region, at least two provinces were selected based on HepB-BD coverage and operational feasibility.

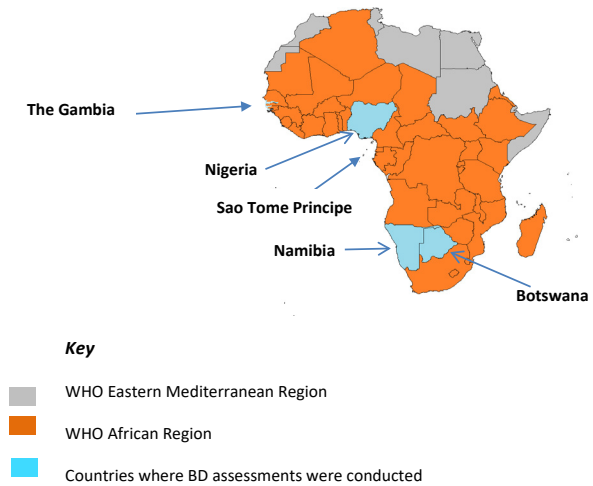

Figure 1: Map showing the 5 countries where BD assessments were conducted

Attempts were made to include at least one high and one low performing province. Provinces with <10% coverage were excluded a priori. In each province, convenience sampling was done to identify a sample of 6 to 8 health facilities that provided delivery services. The main national referral hospitals in each country were selected. Private facilities were deliberately selected in cities such as Lagos with a heavy private sector presence.

At national level, health policies and programme documents including previous EPI reviews and recent Gavi progress reports were reviewed to obtain basic programmatic data. A review of WHO and the United Nations Children's Fund (UNICEF) immunization coverage estimates which are based on data reported by countries through the Joint Reporting Form (JRF) was conducted. Interviews were conducted with Ministry of Health (MoH) officials regarding national HepB-BD and Maternal and Child Health (MCH) policies, training, supervision and vaccine management.

Evaluators drawn from MoH and WHO were trained to collect data using common assessment questionnaires which were developed during a February 2015 HepB-BD consultative workshop which was held at the WHO Regional Office for Africa (AFRO) in Brazzaville, Republic of Congo. The questionnaires contained structured and unstructured questions surrounding HepB-BD implementation. At each visited health facility, EPI and maternity supervisors were interviewed about HepB-BD vaccination policy, practices, knowledge and barriers, including those related to home births. They were questioned about any previous training in basic emergency obstetric and neonatal care (BEmONC), and whether the trainings endorsed the provision of timely HepB-BD. Evaluators observed vaccine handling and storage at each health facility. For each facility, data was collected on the number of births that had taken place in the year preceding the assessment, and the number of infants who had received a dose of HepB-BD. Finally, a record-based coverage assessment was conducted for each facility to calculate two estimates: (1) total HepB-BD (doses administered any time after birth), and timely HepB-BD (doses given on the day of birth or the day after). A random sample of recent births was identified from the maternity register and later searched for in the immunization registry. The date of the vaccine dose was compared against the date of birth to determine the

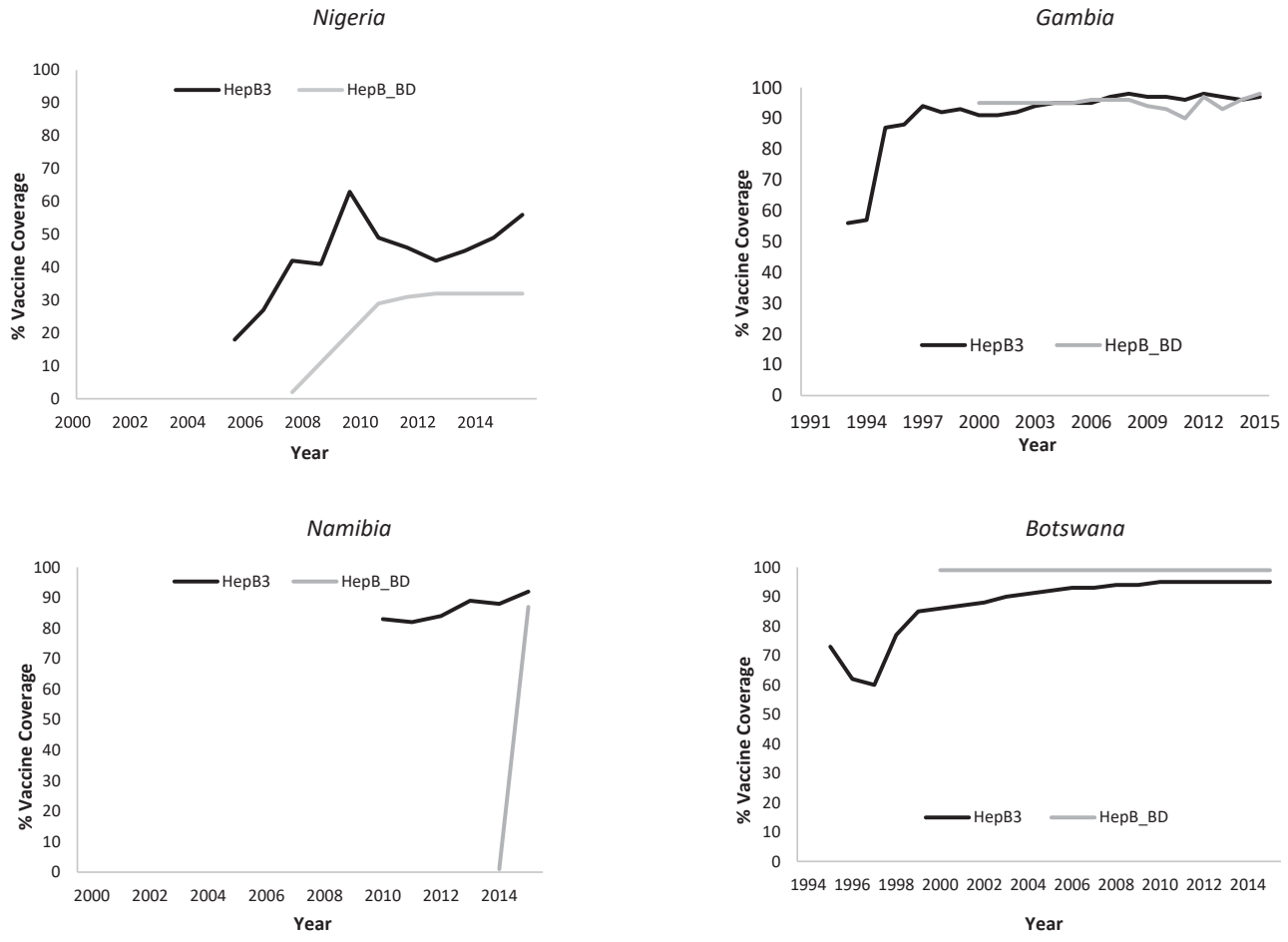

Figure 2: Childhood Hepatitis B vaccination coverage in the countries with birth dose assessments

timing of HepB-BD administration. A modified protocol was employed in Namibia as the HepB-BD assessment was embedded in a larger comprehensive EPI and surveillance review and did not include a record-based coverage assessment component.

Data were entered, cleaned and analyzed using a Microsoft Excel database[26]. Descriptive statistics like frequencies and proportions were used to summarize the data. The assessments were funded by WHO and were exempted from ethical approval for human subjects from institutional review boards.

Results

A total of 78 health facilities were visited during the assessments: STP 5 (6%), Nigeria 23 (29%), Gambia 9 (12%), Botswana 16 (21%), and Namibia 25 (32%) (Figure 1). The health facilities were a combination of public hospitals and health centers and private health facilities. All 78 facilities provided hepatitis B vaccination services (Table 1). The total number of deliveries per year in the selected health facilities ranged from 167 (range: 19–6,000) in Botswana to 1719 (range: 500–6,000) in the Gambia. All health facilities in STP were keeping mothers in the post-natal ward for at least 24 hours after delivery, as compared to facilities in Nigeria (43%), the Gambia (33%), and (13%). (Figure 2)

A total of 1,196 records were evaluated in the three countries where capture-recapture sampling was conducted: Botswana (400), Nigeria (571), and the Gambia (225). HepB-BD coverage calculations were not possible in STP because maternal HBsAg status was not documented in delivery registers. High total HepB-BD estimates were attained in the Gambia 84% (range: 60–100%), though

Table 1: Facility characteristics and vaccine knowledge, practices, and management for the countries with Hepatitis B birth dose assessments[1]

	STP (n=5)	Nigeria (n=23)	Gambia (n=9)	Botswana (n=16)
Background characteristics				
Total number of deliveries (median [range])	336 (31–4,383)	278 (25–1,667)	1719 (500–6,000)	167 (19–6,000)
100% of mothers stay >=24h post delivery	5 (100%)	10 (43%)	3 (33%)	2 (13%)
Staff Knowledge				
Received training on HepB-BD	4 (80%)	14 (61%)	6 (56%)	2 (13%)
Know that a mother can transmit HBV to her baby	5 (100%)	23 (100%)	8 (92%)	12 (75%)
Know that recommended HepB-BD administration is <24h of birth	5 (100%)	23 (100%)	7 (71%)	14 (88%)
Practices				
Vaccinate ALL newborns with HepB-BD	0 (0%)	23 (100%)	9 (100%)	16 (100%)
Follow standard written protocols for HepB-BD administration	0 (0%)	6 (26%)	0 (100%)	0 (100%)
Provide written documentation of HepB-BD to mother	5 (100%)	22 (96%)	9 (100%)	16 (100%)
Vaccinate in the delivery room	5 (100%)	6 (26%)	0 (100%)	1 (6%)
Administer to very low weight babies (<2kg)	4 (80%)	9 (39%)	2 (22%)	0 (0%)
Administer to premature babies	3 (60%)	6 (26%)	1 (11%)	1 (6%)
Administer to ill but stable babies	1 (20%)	7 (30%)	2 (22%)	1 (6%)
Provide HepB-BD outreach vaccination to home births	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Charge patient for HepB-BD administration	0 (0%)	2 (9%)	0 (0%)	2 (13%)
Patients sometimes refuse HepB-BD	0 (0%)	1 (4%)	0 (0%)	1 (6%)
Offer HepB-BD vaccination daily	5 (100%)	0 (0%)	0 (0%)	16 (100%)
Require a physician order for HepB-BD	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Vaccine management				
Stock out >2 weeks in 2014	0 (0%)	0 (0%)	0 (0%)	2 (13%)
Vaccine fridge is EPI-approved	5 (100%)	12 (52%)	9 (100%)	16 (100%)
Observed VVM stage 3-4 in fridge	0 (0%)	1 (4%)	0 (0%)	0 (0%)
Fridge monitored at least 2x/day	5 (100%)	6 (26%)	9 (100%)	16 (100%)
Vaccine obtained from MOH EPI	5 (100%)	23 (100%)	9 (100%)	16 (100%)
Implement multi-dose vial policy		23 (100%)	9 (100%)	16 (100%)

[1]A modified protocol was employed in Namibia as the HepB-BD assessment was embedded in a larger comprehensive EPI and surveillance review, and did not include comprehensive facility assessment component.

the timely estimate was significantly lower 7% (range: 16–28%). Only 9% of infants who received HepB-BD in the Gambia were vaccinated within 24 hours of birth. The median days to receiving HepB-BD was 11 days (IQR: 6–16 days), and majority (42%) were vaccinated between 8 to 14 days. Nigeria had low total 23% (range: 12–40%), and timely HepB-BD coverage 13% (range: 2–21%). Botswana had high total HepB-BD coverage estimates (94% [range: 80—100%]), with the highest found in facilities in Kwaneng West province (98%), and the lowest in Gaborone (89%). However, Kwaneng West facilities had the lowest timely HepB-BD estimates (62%). Private hospitals had the highest total coverage (99%), and the National referral hospital followed closely at 80%. Overall, timely HepB-BD coverage in Botswana was 74% (range: 57-88%).

Overview of the National HepB-BD programmes

All five countries are highly endemic for HBV (Table 2). However, none of the 5 countries had conducted nationally representative seroprevalence assessments. With the exception of STP, all are countries have policies for universal vaccination with monovalent HepB-BD given soon after birth, and 3 doses of pentavalent vaccine. STP introduced HepB-BD in 2002 and is using a selective screening and targeted vaccination approach. Women are routinely screened for HBsAg during antenatal care (ANC) visits, and only babies of HBV-seropositive (HBV+) mothers receive HepB-BD. HBV+ mothers were counselled on importance of delivering in hospitals to ensure their newborns receive HepB-BD and other postnatal care (PNC) services. In 2015, STP reported high national coverage for HepB3 (96%) but low HepB-BD (3%)[14]. This low rate is thought to be due to denominator issues which did not allow for appropriate statistical analysis. However, coverage among infants born to HBV+ women is high (92%). Nigeria introduced HepB-BD in 2004 but the 2015 coverage estimates for both HepB-BD (32%) and HepB3 (56%) are low. The Gambia introduced HepB-BD in the 1990s and has consistently maintained high coverage rates for HepB-BD (98%) and HepB3 (97%). Botswana introduced HepB-BD in the 1990s and has maintained high (90%) national coverage rates. Namibia introduced HepB-BD in 2014 and in 2015 attained a high post-introduction coverage of 87%, and 92% coverage rate for HepB3.

HBV is a priority health issue in all five countries, and there is a strong political support to implement HepB-BD. All countries had national policies for the timing of HepB-BD administration, ranging from within 24 hours in Nigeria to up to 2 weeks after birth in Namibia (Table 3). A change in the vaccination policy in Nigeria in February 2015 restricted HepB-BD administration to only within 24 hours of birth and EPI tools were revised accordingly. National EPI reporting and recording tools in all 5 countries had designated columns for HepB-BD, though some health facilities were still using outdated versions

Table 2: Hepatitis B birth dose coverage, institutional births, and antenatal care visits in the 5 African countries with birth dose assessments

Country	% HBsAg prevalence (min %, max %)	Year HepB-BD introduced	Annual Births (1000s)[1]	Institutional deliveries %[2]	Births attended by SBA %[2]	>1 ANC visit %[2]
Botswana	5.3, 10.6 (35–37)	Pre 2000	55	100	95	94
Gambia	8.5, 9.1 (38–40)	1990	83	63	57	86
Namibia	7.8, 13.6 (41–43)	2014	72	87	88	97
Nigeria	6.7, 17.2 (44–46)	2004	7,133	36	38	61
Sao Tome and Principe[3]	6.1, 10 (47)	2002	6	91	93	98

[1]Annual birth data is derived from the WHO Immunization Monitoring System (updated May 2016) http://apps.who.int/immunization_monitoring/globalsummary.

[2]Data derived from UNICEF (updated February 2016) www.data.unicef.org

[3]Sao Tome and Principe does not offer the birth dose universally, but follow a selective policy where infants of mothers that test HBsAg are offered vaccine

Table 3: National level characteristics and policies for the 5 countries with birth dose assessments

	STP	Nigeria	Gambia	Botswana	Namibia
National plan focusing on prevention and control of viral hepatitis	No	No	No	No	No
Designated govt. unit responsible for carrying out viral hepatitis activities	No	Yes	No	No	No
National representative sero-survey data showing HBV burden	No	No	No	No	No
National clinical guidelines for managing viral hepatitis	No	No	No	No	No
National guidelines/policy related to HepB-BD vaccination	Yes	Yes	Yes	Yes	Yes
Have an upper limit for timely HepB-BD vaccination (≤24 hrs.)	No	Yes	No	No	No
EPI recording tools allow for capture of timely (≤24 hrs.) and total BD doses	No	No	Yes	No	No
HepB-BD integrated in newborn care policy	No	No	No	No	No
MCH data recording tools capture HepB-BD administration	No	No	No	Yes	No
Outreach programs to vaccinate home births within 24 hours	No	No	No	No	No