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Susceptibility of healthcare workers in Kenya to hepatitis B: new strategies for facilitating vaccination uptake

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Summary Hepatitis B virus (HBV) infection is preventable, yet many healthcare workers (HCWs) in resource-poor countries remain at risk. The aims of this study were to evaluate the susceptibility of HCWs in a Kenyan district to HBV infection, and the feasibility of expanding the Extended Programme of Immunization (EPI) for infants to incorporate hepatitis B vaccination of HCWs. HCWs in Thika district, Kenya were invited to complete an interviewer-administered questionnaire about their immunization status and exposure to blood or body fluids. Participants were asked to provide a blood sample to assess natural or vaccine-induced protection against HBV. All non-immune HCWs were offered hepatitis B vaccination. Thirty percent (168/554) of HCWs reported one or more needlestick injuries (NSIs) in the previous year, with an annual incidence of 0.97 NSIs/HCW/year. Only 12.8% (71/554) of HCWs had received vaccination previously and none had been screened for immunity or for hepatitis B surface antigen. In total, 407 staff provided blood samples; 41% were HBV core antibody, 4% expressed hepatitis B surface antibody from previous vaccination, and 55% were unprotected. Two hundred and twenty-two staff were eligible for vaccine delivered through the EPI infrastructure. Self-motivated uptake of a full course of vaccine was 92% in the smaller health centres and 44% in the district hospital. This study demonstrates the

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importance of hepatitis B vaccination of HCWs in parts of Africa where high exposure rates are combined with low levels of vaccine coverage. High rates of vaccination can be achieved using childhood immunization systems for the distribution of vaccine to HCWs.

Background

Hepatitis B virus (HBV) infection has been preventable by vaccination since the early 1980s. Despite being safe, efficacious and cost-effective, hepatitis B vaccination is still consistently underutilized.[1,2] Approximately 88% of the world's population live in areas where the prevalence of chronic HBV infection is moderate to high.[3] For such countries, the Global Advisory Group in 1991 recommended the incorporation of hepatitis B vaccine into the routine Extended Programme of Immunization (EPI) schedules for infants as a cost-effective public health intervention.[4,5]

While progress has been made in targeting infants, it will be some time before these benefits are realized in the adult population. Exposure to HBV from carriers remains a serious risk to healthcare workers (HCWs) in resource-poor countries,[6,7] although the exact risk in a specific healthcare setting is rarely quantified.[8] Existing studies of hepatitis B amongst HCWs in resource-poor settings indicate variation in prevalence rates and vaccination coverage that reflect national policies and prevalence rates.[9–12] The additional risks posed by exposure-prone procedures are known to be highest for medical staff during the first five years of employment.[13,14] However, few HCWs in resource-poor settings are vaccinated adequately and even fewer are screened.[15–18] Hepatitis-B-infected HCWs also pose a risk to patients. Therefore, vaccination of HCWs has the potential to protect patients undergoing exposure-prone procedures.

In a moderate-prevalence setting, such as Kenya, chronic carriage rates of hepatitis B are between 3% and 7% and local guidelines promote vaccination of HCWs.[19] In practice, the Kenyan health system is overwhelmed by the impact of human immunodeficiency virus (HIV), and hepatitis B vaccination is often neglected. The high rates of previous exposure to HBV have been used to justify the lack of vaccination of HCWs in a setting where it is deemed impractical and unaffordable.[10] Pre-vaccination screening is not conducted and reagents are only available through government suppliers for the screening of blood for hepatitis B surface antigen (HBsAg). In practice, government HCWs in Kenya are required to purchase and administer their own vaccines and HIV postexposure prophylaxis (PEP). At the start of the study, hepatitis B vaccine and PEP were only available in pharmacies in the largest cities in Kenya.

The aims of this study were to evaluate the susceptibility of HCWs to HBV infection in a representative district in Kenya, the extent of potential exposure through needlestick injuries (NSIs), and the feasibility of expanding the routine EPI for infants to incorporate hepatitis B vaccination of HCWs. The study was undertaken as part of a larger project looking at the feasibility and acceptability of PEP for HIV. Data on HIV PEP will be reported elsewhere. The study design and implementation were developed through a collaborative process with the district health management team, the laboratory services and public health officers responsible for bio-safety.

Methods

Site

The study was undertaken in Thika, a typical Kenyan district situated 60 km north of Nairobi. It has two government hospitals and nine primary healthcare centres serving an estimated population of 700 000.[20] The HIV seroprevalence rate in the district has been reported to be 9–11%.[21] In 2002, when the study commenced, there was no district system for administration of hepatitis B vaccine or for reporting NSIs, and no PEP for HIV. The cold chain for childhood immunizations was maintained by gas-run refrigeration in centres without electricity.

Participants

An interviewer-administered questionnaire was conducted in English and/or Kiswahili by the co-investigators. Participants comprised all HCWs involved in direct patient care, laboratory staff and all staff involved in the disposal of waste. Staff lists for the hospitals and health centres were obtained from the district medical officer of health and confirmed by the district health management team. Lists of casual employees and student nurses

on attachments were obtained from the departmental or health centre managers. Staff were excluded if they were unable to speak English or Kiswahili, had been transferred out of the district, were on permanent night shifts or were absent for a period exceeding three months.

Survey questions

Questions focused on current immunization status, the number of vaccine doses, the time since immunization and whether the HCW knew their current hepatitis B status. HCWs were also asked about occupational exposure to blood or body fluids, number and type of exposures, precautions taken and the circumstances of the injury.

Serological testing

Each staff member interviewed was asked for their consent for a blood sample to be drawn and serum was tested for both HIV and hepatitis B core antibody (anti-HBc). Staff who reported previous vaccination were also tested for hepatitis B surface antibody (anti-HBs) and levels of >100 mIU/mL were considered to be fully protective. Levels of 10—100 mIU/mL were considered to require one further booster and those with levels of <10 mIU/mL were defined as non-responders. HBsAg was not tested and HIV testing was anonymous and unlinked. Reagents for anti-HBc testing were imported from South Africa and samples were transported daily from remote health centres to Nairobi for storage and analysis. Serum was tested in the Kenya Medical Research Institute Virology Laboratory using enzyme-linked immunosorbent assay techniques (Monolisa Anti-HBs 3.0 and Anti-HBc Plus; BioRad, Marnes La Coquette, France). Funding restrictions meant that positive results could not be confirmed with a second test, so a higher cut-off index (>1.5) was used. Ten percent of samples were sent to Nairobi Hospital Laboratory for external quality assurance.

Vaccine distribution

All individuals who gave blood samples received their anti-HBc antibody results by letter. Those staff who were anti-HBc positive were informed that they did not require vaccination. Those who tested negative were offered a full course of three doses of hepatitis B vaccine if they had no previous vaccine history. Those who tested negative and had been previously vaccinated were offered revaccination if surface antibody levels were <10 mIU/mL. Previously vaccinated staff with anti-HBs antibody 10—100 mIU/mL were offered a booster dose, whilst those with levels >100 mIU/mL were informed of the level of protection. While boosters in immunocompetent responders are unlikely to be necessary,[22,23] they were offered in this study as the HIV seroprevalence rate in the district was 11%. All hepatitis B vaccines were made available through the existing cold chain for childhood immunization. The uptake of vaccination was left entirely to the staff, and administration was left to their immediate colleagues. In line with the official policy in some countries, postvaccination anti-HBs levels were not checked.[22]

Statistical analyses

Simple summary statistics were calculated. Proportions of staff exposed were compared using odds ratios (ORs) from two-by-two tables, and a P value of <0.05 was considered to be significant. Data were analysed using EpiInfo 2000.

Results

In total, 650 HCWs were at risk of NSIs in the district (496 permanent positions, 100 nursing students on placement, and 54 casual and day labourers). Interviews were conducted with 554 staff, with 72 exclusions (permanent night shifts, long-term leave, and transfers out of the region) and 24 HCWs declining to be interviewed. Study participation, serological results and vaccine uptake are summarized in Figure 1. Of the interviewees, 78% were female and 63% were nurses, similar to the overall proportions in the district staff. Student nurses taking part in the study were more likely to be placed in the district hospital (OR 2.73, $P < 0.001$). The 407 HCWs that gave a blood sample for HIV and hepatitis serology (73% of those completing the questionnaire) had similar ages and occupational characteristics to the 147 HCWs who did not give blood. There was no significant difference in the number of reported NSIs or sharps injuries or knowledge of HIV status. However, men (OR 1.6, $P = 0.003$) and previously vaccinated staff were less likely to give blood (OR 0.58, $P = 0.04$) than their female and unvaccinated colleagues.

Exposure risks

Thirty percent of HCWs reported one or more NSIs in the preceding year. The annual incidence in this cohort was 0.97 NSIs/HCW/year. Doctors, clinical

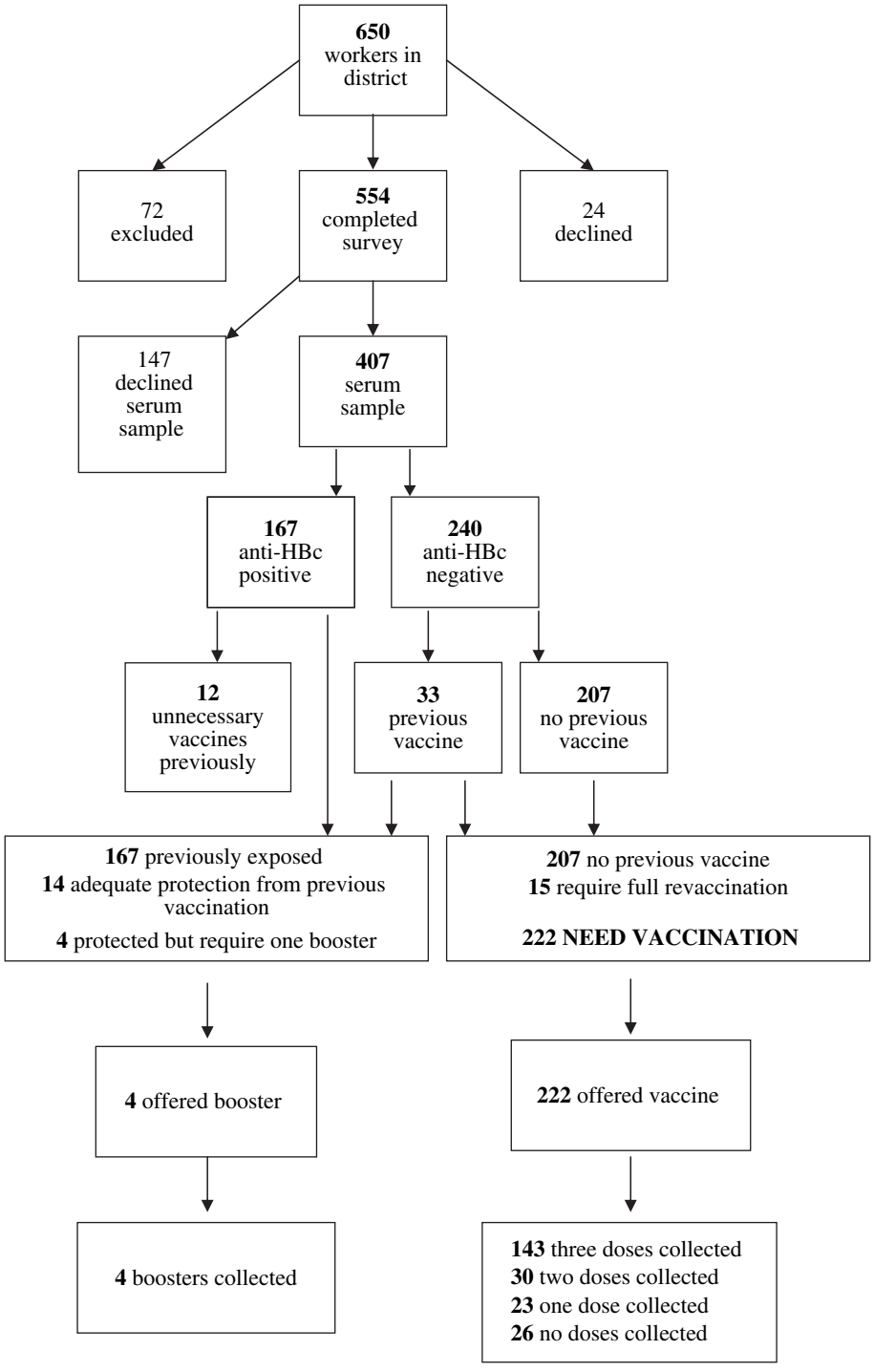

Figure 1 Survey results.

officers and midwives had the highest rates of repeated injuries.

Levels of protection

Eighty-seven percent (483/554) of participants had never been vaccinated for hepatitis B. The remainder (71/554) had been vaccinated between 1 and 22 years previously. None of the HCWs in either group had previously received any pre- or postvaccination screening for hepatitis B and did not know whether they had been previously exposed (and therefore not requiring vaccination) or whether they had responded to vaccination or needed boosters. On serological testing, 12 out of the 45 previously vaccinated staff who gave blood

were anti-HBc antibody positive. Of the remaining 33 HCWs who were anti-HBc antibody negative, 14 were considered to be adequately protected with anti-HBs antibody >100 mIU/mL and 15 had no detectable anti-HBs antibody or levels <10 mIU/mL. The four HCWs with anti-HBs antibody 10–100 mIU/mL were offered a booster dose of vaccine.

Of those who gave blood, 41% (167/407) were anti-HBc antibody positive and did not need vaccination, including 12 HCWs who had been unnecessarily vaccinated. Anti-HBc antibody positivity was lowest in doctors and clinical officers (OR 0.34, $P = 0.027$) and highest in subordinate and casual staff (OR 2.04, $P = 0.042$). HCWs less than 30 years of age were significantly less likely to have been infected by HBV (OR 0.37, $P < 0.001$) than their older colleagues. A history of previous vaccination was associated with protection (OR 0.49, $P = 0.037$).

Uptake of vaccination

In total, 222 staff were offered vaccination courses and four were offered a booster dose. As a result of the study, 514 out of a possible 670 doses of vaccine were administered at 11 health centres. The normal cold chain proved to be an effective means of vaccine distribution and effective follow-up on vaccine delivery. The nurse responsible for childhood immunizations was able to administer and sign for doses.

Table I gives a detailed breakdown of vaccine uptake. Uptake was highest in the subdistrict hospital and in the smaller health centres, where only seven out of 93 staff failed to collect all three doses of vaccine, and only two staff failed to collect any of the doses. By contrast, only 57 out of 129 staff at the district hospital collected all three doses. Of those who did not attend or who only collected a single dose (44 staff), seven had been transferred, seven were given a new student placement, and five had completed casual contracts, reflecting a much more transitory staff population.

Discussion

This study demonstrates to policymakers the ongoing need for hepatitis B vaccination in resource-poor settings where high exposure rates are combined with low levels of vaccine coverage. It also demonstrates the feasibility and acceptability of the childhood EPI infrastructure for the distribution and administration of vaccine to HCWs. Vaccination was conducted without any additional incentives to staff administering or receiving vaccination.

Study participation was high. Eighty-five percent of all HCWs in the district took part in the study and 73% of these gave serum for testing. While women were more likely to give blood than men, many staff were initially reluctant to do so. The rates of participation may reflect staff concerns about their health, the incentive of free vaccination and the perceived trustworthiness of the researchers. The study conducted anonymous HIV testing and did not test for HBsAg carriage, which may also have contributed to the high participation rates.

Feasibility and acceptability of screening and vaccination

Studies have shown prevaccination screening to be cost-effective in high-prevalence settings. In addition, postvaccination screening evaluates antibody response and is of particular benefit in the immunocompromised. The fact that postvaccination levels were not checked in this study means that some HCWs will believe that they are protected when, in fact, they have not responded to the primary course. The finding that previously vaccinated HCWs were less likely to provide a blood sample may also reflect a degree of complacency over the efficacy of the vaccine. However, it would require significant resources and training for pre- or postvaccination[24,25] screening to be conducted in a Kenyan district such as Thika. While a formal costing of this study was not conducted, it is possible that the costs of screening would be balanced by the savings from unnecessary hepatitis B immunization.

Table I Uptake of hepatitis B vaccine through Extended Programme of Immunization systems

Health facility	Staff needing booster	Booster given	Staff needing three doses	Uptake of three doses	Uptake of two doses	Uptake of one dose	Uptake of no doses
District hospital	2	2	129	57	28	20	24
Subdistrict hospital	1	1	36	36	0	0	0
Health centres	1	1	57	50	2	3	2
Total	4	4	222	143	30	23	26

Routine testing of HCWs for chronic carriage of HBV and/or HIV could be conducted but has ethical, economic and practical implications for policymakers if treatment is to be offered or if positive HCWs are to have restrictions placed on their practice. The suspicions expressed by HCWs about giving blood for analysis imply that they are aware of potential implications and associated stigma. Any vaccination strategy requiring blood samples from HCWs is unlikely to have high coverage in this setting.

The feasibility and acceptability of providing vaccination through EPI systems was demonstrated. Overall, 78% of staff took up either a full course or two doses (i.e. sufficient to initiate anti-HBs production) of hepatitis B vaccination.[22] The 100% uptake of booster doses was expected in this self-motivated group. However, the significant difference between vaccine uptake in the smaller health centres and the district hospital (92% compared with 44% taking the full course) is likely to reflect a more transitory population with transfers out of the region and increased numbers of students and casual staff. This has importance not only for medical training colleges but also for the government policy on transfers.

This study has shown that a vaccination programme conducted through existing systems for childhood immunization can lead to high rates of vaccine uptake. Policymakers in Africa, taking advantage of cheaper vaccines and improved coordination and monitoring through the Global Alliance for Vaccines and Immunizations,[26] could combine EPI systems with a universal vaccination programme for adult HCWs. While an economic analysis was beyond the scope of this study, the use of existing cold chains and staff is likely to be cost-effective for such a programme. The most effective way to reach non-permanent staff may be by medical and nursing institutions taking a preventive approach. In order for a vaccination programme for permanent staff to be effective, the responsibility of occupational health would need to be allocated to particular individuals represented on a district health management team. Local guidelines and reporting procedures would also need to be facilitated. Ministries of Health in Africa are large employers and effective, focused strategies are needed to improve the implementation of guidelines for the protection of HCWs.

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