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Seroprevalence and Knowledge of Hepatitis B and C among Healthcare workers in three healthcare centers in Nigeria

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Abstract

The study investigated the seroprevalence and knowledge of viral hepatitis B and C infections among healthcare workers in three medical centers in Karu Local Government area, Nasarawa State, Nigeria. A cross-sectional study design was used in this study and data was collected using quantitative method. Structured interviewer-administered questionnaires were administered to 215 healthcare workers who were tested for HBsAg and anti-HCV using rapid hepatitis screening kits (ACON Laboratories biotest rapid diagnostic strips, USA). Data was analyzed using Chi square test and the level of significance, alpha – α, was set at < 5%. The overall seroprevalence of hepatitis among the healthcare workers were HBsAg 13.0% and HCV 2.8%. Seroprevalence of HBsAg among the unskilled workers was the highest at 4.6 %. There was no significant association between HBsAg and HCV seroprevalence across all the cadres ($p \leq 0.05$). Doctors demonstrated a good knowledge of HBsAg and HCV (88%) compared to unskilled workers with poor knowledge scoring (9%). Knowledge base among HCWs was insignificant ($p < 0.05$). Although, the skilled HCWs had the highest screening and vaccination uptake, there was no statistically significant association ($p \leq 0.05$) between the HBsAg prevalence, screening and vaccination across all the cadres. This study revealed a significant level of seroprevalence of HBsAg and HCV among the HCWs and poor knowledge, and low screening and vaccine uptake among unskilled workers in the three medical centers.

Keywords: Healthcare Workers; Hepatitis B; Hepatitis C; Knowledge; Seroprevalence; Vaccination.

1.0 Introduction

Infections with hepatitis B virus (HBV) and hepatitis C viruses (HCV) are global public health problems which affect approximately 350 and 150 million people worldwide, reaching endemic proportions in Sub-Saharan Africa (Ogoina *et al.,* 2014; Westermann *et al.,* 2016). The global disease burden due to acute hepatitis B and hepatitis C, cirrhosis of the liver and hepatocellular cancer is high and projected to become a higher ranked cause of death over the next two decades (WHO, 2017).

Healthcare workers (HCW) are defined as persons, for example, employees, students, clinicians, or volunteers), whose activities involve contact with patients or with blood or body fluids from patients in healthcare, laboratory or public safety setting (Lee *et al.,* 2017). Throughout the world, millions of healthcare professionals work in

health Institutions and an estimated 600,000 to 800,000 cuts and puncture injuries occur among healthcare providers per year (Ghosh, 2013). Periodic survey of the populace, particularly the healthcare workers for prevalence, knowledge and awareness of viral hepatitis is vital in reducing the burden of this disease and its complication in the society.

The high association of viral hepatitis with mortality and morbidity is well established (Miao *et al.,* 2020), therefore, remains a source of concern to all, especially in the developing countries where inadequate health facilities still struggle with basic medical diagnosis and emphasizes more on treatment of disease conditions rather than prevention.

Hepatitis B and C viruses can be transmitted by exposure to percutaneous injuries (needle-sticks/ injection drug use) or body fluid contaminated with blood containing the virus, or invasive procedures such as phlebotomy, haemodialysis and surgery involving infected blood or instrument contaminated with these viruses (Dehghani *et al.,* 2019). The experience of the HCW and expertise of the practitioner including the frequency by which healthcare workers or trainees sustain injuries is associated with transmission of these viruses.

Viral hepatitis infections particularly HBV, are preventable through vaccination and other prophylactic measures. Control and post-exposure prophylaxis (PEP) for HBV is a well-established protocol for healthcare workers and those at risk in a well-developed health setting (Isunju *et al.,* 2022). Clinicians are commonly at risk of hepatitis infection due to constant contact with needlestick injury, blood and body fluids (Kacem *et al.,* 2022, Elzouki, 2014), however, evidence of a high risk of exposure to HBV and HCV have been demonstrated among non-clinicians due to poor knowledge of viral hepatitis, poor screening and vaccine uptake (Orji *et al.,* 2020, Ijoma *et al.,* 2021; Osagiede *et al.,* 2020) thus increasing the occupational risks of health workers. Issa *et al.* (2023) conducted a survey in which 857 HCWs were tested in six tertiary and six secondary health facilities across the six geopolitical zones in Nigeria with a total of 28.9% unvaccinated healthcare workers while 0.13% HCV - infected HCWs were reported in a university teaching hospital in Tunisia (Kacem *et al.,* 2022).

The World Health Assembly Global Health Sector strategy (GHSS) on viral hepatitis 2016-2021 targets the elimination of hepatitis as a public health threat by 2030. Five focus intervention areas are HBV vaccination, prevention of mother-to-child transmission of HBV, injection and blood safety, harm reduction and testing and treatment of HBV and HCV (WHO, 2016). The WHO goal and strategy for global action for the prevention and control of viral hepatitis, can be boosted by ascertaining the burden of these diseases among the at-risk group, including the HCWs (WHO, 2012). To achieve the elimination goal in Nigeria, data on the at-risk group is required from all states across the country including Nasarawa State. This study aims to assess the seroprevalence, knowledge of HBsAg and HCV infection, and vaccine uptake of HBsAg vaccine among healthcare workers in three medical centers in Karu, Nasarawa State, Nigeria.

2.0 Materials and Methods

2.1 Study area

The study was conducted between January and March 2019 among employees in three healthcare centers in Karu local government area, Nasarawa State, North Central, Nigeria. Karu LG is in close proximity to the Federal capital territory and 165.5 km from Lafia, the capital of Nasarawa State. Karu is located between latitude 9 0'N of the equator and longitude 7 6'E and situated on an altitude of 422 m above sea level of Greenwich Meridian.

2.2 Study design

The cross-sectional study followed a multistage sampling technique where the different strata of healthcare workers tested in this study were selected using stratified random sampling.

The employees enrolled were categorized into five main groups: Doctors, Nurses, Allied health workers (AHWs) (Medical laboratory Scientist, Pharmacist, Imaging Scientist, Physiotherapist), Administrative Staff (hospital secretary, Accountant, Cashier and Store officer, hospital card issuers and the hospital securities) and unskilled staff (ward attendants, laundry staff, compound laborer and cleaners). All currently employed staff that participated in the study, during a 12-week period, were recruited with support of the hospital management to attend the study recruiting site within the hospital premises.

2.3 Sample size determination

The sample size was estimated using a previous local study. The prevalence of HBsAg infection was estimated at 15%, based on the mean prevalence value obtained from other studies in Nigeria and Africa (Musa *et al.,* 2015).

Using the Kish (Kish, 1965) sample size formula for cross-sectional studies, a sample size of 195 was calculated to achieve a 5% margin of error in estimating the HBsAg and HVC prevalence rate at a 95% confidence level in the healthcare workers population. However, an effective size (total sample size of 215) was estimated to ensure the adequacy of the sample size to screen for both HBV and HCV infections, assuming HBV is more prevalent but that minimal co-infection exists in the study population. A 10% non-response rate was adapted from a previous study (Demsiss *et al.,* 2018).

The sample size was calculated as follows:

$$Initial\ sample\ size\ (n) = (Z_{\alpha}^{2} P \times q) \div d^{2} \quad (1)$$

Where;

Z_{α}^{2}= alpha deviate at 95% confidence interval (CI) =1.96

P = prevalence from previous studies =15% i.e. $P = 15 \div 100 = 0.15$ (2)

$$q = 1 - P = 1 - 0.15 = 0.85 \quad (3)$$

$$d = degree\ of\ precision\ or\ error\ margin\ (EM) = 0.05 \quad (4)$$

$$n = ((1.96^{2} \times 0.15 \times 0.85) \div (0.05)^{2}$$

$$n = (3.8416 \times 0.127) \div 0.0025 = 195$$

Therefore, initial sample size is 195.

$$Final\ sample\ size\ (N) = n^{+} non - response\ rate\ (NRR) \quad (5)$$

Where;

NRR=10% of the initial sample size(n) = $^{10}/_{100} \times 195 = 19.5$

n= 195

Hence final sample size (N) =195+19.5 = 215

Overall, 215 consenting participants completed the study questionnaire and provided a blood sample for testing. The number allocated to each cadre of HCW was calculated proportionately by using the following formula.

$$^{n}/_{N} \times 215 \quad (6)$$

where n= number of HCW in a cadre in the medical Centre

N= total number of HCWs in the medical centre.

Participation of HCWs across the cadres was voluntary and anonymous. Confidentiality of participants was maintained throughout the study period and there were no financial or material incentives for participation. Participants were educated on the significance of the study and the format of the structured questionnaire was self-administered. Prior to phlebotomy, informed consent was obtained from each individual participant as well as pre-test counselling.

2.4 Ethical approval

Ethical approval was obtained from the hospital ethical committee of Nasarawa State Hospital Management Board (NSHMB) and the study was performed in accordance with the ethical standard laid down in the 1964 declaration of Helsinki.

2.5 Criteria for selection

2.5.1 Inclusion criteria

Healthcare workers working in the three health facilities aged between 20-60years who are not in direct contact with patient at risk of Hepatitis B and C, during the study period, and who provided valid informed consent, were eligible for study enrolment.

2.5.2 Exclusion criteria

Healthcare workers without proof of identification of participation, medical and nursing students on clinical placements were not considered as hospital staff and hence were ineligible for recruitment. Workers with history of recent vaccination of hepatitis B, and visitors were excluded.

2.6 Study instrument

Trained interviewers fluent in English and Hausa administered a structured questionnaire in the participant's preferred language. The questionnaire composed of three sections.

The first part of the questionnaire was designed to collect data on demographic characteristics, namely; gender, age, residence, nationality, education level, etc. The second part consisted of 20 questions to test participants' knowledge on the diseases, adapted from a previous study (Geberemicheal *et al.,* 2013). This part was designed to test the participants' knowledge across multiple domains, namely; etiology of the disease, signs and symptoms, modes of transmissions, preventive measures, treatment and vaccination. Each question was scored 1, and incorrect answer was scored 0. The scores were converted to percentages and classified based on the distribution of the cadre. Good and satisfactory knowledge were respectively scored a total of 18 and 14 out of 20 responses and unsatisfactory if the score is below the cutoff point. This cutoff was determined based on the mean score for the entire studied sample at 10.1 ± 3.9.

The third part was designed to identify HBsAg and HCV screening and vaccine uptake among participants. The questionnaire was initially tested with a group of ten participants to ensure applicability and to estimate the time frame for data collection.

2.7 Blood sample collection and processing

Sample collection was carried out at the phlebotomy unit of the respective hospitals. After applying standard antiseptic technique, 5mL of venous blood sample was obtained from the ante-cubital vein of each participant and subsequently introduced into K_3EDTA container by the phlebotomist. Blood samples were transported to the designated hematology laboratory. Blood sample separation technique was undertaken using standard

centrifugation methods at 2000g revolution per minute for 5 minutes. The supernatant plasma samples obtained were assayed for HBsAg and HCV in accordance with the manufacturer's standard operational procedure using the rapid hepatitis screening kits (ACON Laboratories, Inc. USA), and HCV kits (ACON Laboratories, Inc. USA).

2.8 Serological Testing for HBV surface antigen (HBsAg) and HCV antibody (HCVAb)

This is an immunochromatographic rapid test for the qualitative detection of antibodies specific to HCV and HBsAg in blood with a sensitivity of 100% and specificity of 99.4% according to manufacturer's instructions found on the standard operation procedure insert. The seropositive samples of HBsAg and anti-HCV detected by Rapid Diagnostic Tests screening were further confirmed by using third generation test kits for HBsAg and HCV according to manufacturer's specifications.

2.8.1 Principle of the test

HBsAg Detection: A rapid *in-vitro* diagnostic kit which is a qualitative sandwich immunoassay was used to screen the plasma for HBsAg. The test kit (one step strips, ACON, USA) utilizes a combination of monoclonal and polyclonal antibodies to detect HBsAg in plasma. The test procedure and result interpretation were carried out according to the manufacturer's instructions.

2.8.2 Anti-HCV Detection: A rapid *in vitro* diagnostic kit (HCV one step strip, ACON, USA) was used for the detection of anti-HCV in plasma. This kit uses recombinant proteins and synthesized peptides derived from core and structural regions of HCV for the detection of anti-HCV in plasma. The test procedure and result interpretation were carried out according to the manufacturer's instructions.

2.9 Statistical analysis

Data was processed using the Statistical Package for Social Sciences SPSS (version 21.0 Inc., Chicago IL, USA). Descriptive statistics were used to present data of all variables. Chi-square test of independence was performed to determine the association between hepatitis B and C seroprevalence across the cadres of healthcare workers, occupational cadre and knowledge of hepatitis B and C and vaccination uptake among the healthcare workers.

3.0 Results

3.1 Sex distribution of healthcare workers in the three medical centers

A lower number of male healthcare workers, 40.9% (88/215) volunteered for enrolment in the study compared to their female counterparts, 59.1% (127/215), across all the occupations. (Table 1).

Table 1: Sex distribution of healthcare workers in the three medical centers

Occupation	Number of participants (%)	Sex	
		Male	Female
Doctors	21(9.76)	9(10.23)	12 (9.45)
Nurses	45 (20.93)	12(13.64)	33(25.98)
AHWs	65 (30.23)	26 (29.55)	38(29.92)

Administrative staff	21(9.76)	11(12.5)	11(8.66)
Unskilled workers	63(29.3)	30(34.09)	33(25.98)
Total	215	88	127

3.2 Sociodemographic distribution of healthcare workers in the three medical centres

The baseline sociodemographic characteristics of the study population are presented in Table 2. Age stratification of workers ranged between 20 - 59 years and the highest number of healthcare workers were within a mean age of 39 years (39.9%, 86/215). Occupationally, the allied workers were the highest enrolled staff (65/215), and married workers had the highest frequency (61.8%, 133/215). Majority of the workers have tertiary education (49%, 105/215) and live in the urban areas (67.4%, 145/215).

Table 2: Sociodemographic characteristics of healthcare workers in the three medical centers

Variable	**Frequency (n=215)**	**Percentage (%)**
Age bracket		
20 - 29	45	21.1
30- 39	86	39.9
40 -49	65	30
50 -59	19	9.0
Occupation		
Doctors	21	9.7
Nurses	45	21.0
Allied Health workers	65	30.0
Administrative staff	21	9.7
Unskilled workers	63	29.4
Marital status		
Married	133	61.8
Unmarried	58	26.9
Divorced	10	4.7

Widowed	14	6.6
Education		
Primary	72	32.6
Secondary	38	18.4
Tertiary	105	49.0
Residence		
Urban	145	67.4
Rural	70	32.6

3.3 Seroprevalence of hepatitis B and C among healthcare workers

The overall seroprevalence of HBsAg and HCV were 13.0% and 2.8%, respectively (Table 3)**.** The seroprevalence of HBsAg among the categories of HCWs vary in the (delete) distribution with highest prevalence of 4.6 % among unskilled workers, 3.2% among Allied health workers, 2.3% among nurses and the lowest seroprevalence of 1.4% among doctors and administrative staff. The highest seroprevalence of HCV infection was found among the unskilled workers at 1.4% while the lowest seroprevalence was found among the doctors with a seroprevalence of 0.5%. None of the allied health workers and administrative staff was seropositive for HCV infection. (Table 3). Chi-square test showed no significant association (p = 0.24) between HBsAg and HCV infections and the occupational cadres of healthcare workers

Table 3: Overall seroprevalence of HBsAg and HCV among healthcare workers

Occupation	**HBsAg (%) N = 215**	**HCV (%) N=215**	X^2	**P-value** ($p \leq 0.05$)
Doctors	3 (1.4)	1 (0.5)	15	0.24
Nurses	5 (2.3)	2 (0.9)		
Allied health workers	7 (3.2)	0(0)		
Administrative staff	3(1.4)	0(0)		
Unskilled	10 (4.6)	3 (1.4)		
Seropositive	**28 (13.0)**	**6 (2.8)**		
Non-seropositive	**187 (87)**	**199(97.2)**		

3.4 Knowledge base of hepatitis B and C among healthcare workers

Knowledge of HBsAg and HCV infection was surveyed and scored among healthcare workers and graded in percentages as good, satisfactory and poor (Table 4). The doctors showed a good knowledge of the HBsAg and HCV infection at 88% score, followed by the nurses at 52% score, then the AHWs at 48% score and administrative staff at 21% score. Administrative staff showed an average knowledge of the infection with a

satisfactory score of 52%. The poorest knowledge of HBsAg and HCV was found among the unskilled workers at 9% score. However, having a good knowledge of HBsAg and HCV infection was not significantly associated ($p = 0.36$) with HBsAg and HCV status of the HCWs.

3.5 Screening and vaccination uptake among healthcare workers in the three medical centres

HBsAg and HCV infection screening and vaccine uptake were surveyed among the healthcare workers (Table 5). Pre-screening test is usually conducted by the hospital as part of the pre-employment criteria for all workers. All the doctors and nurses tested had been previously screened for HBsAg and HCV infection while only few of unskilled workers had previously been screened.

For vaccine uptake, 93% doctors and 91% nurses had been vaccinated while only 21% unskilled workers had received the vaccine. Chi square test showed no significant association ($X^2 = 11.3$, $p = 0.26$) between screening and HBsAg and HCV seroprevalence. Likewise, vaccine uptake and HBsAg and HCV status across the cadres of healthcare workers was statistically insignificant ($X^2 = 15.0$, $p = 0.24$).

Table 4: Distribution of participants based on knowledge of HBsAg and HCV

Occupation	**Good (%)**	**Satisfactory (%)**	**Poor (%)**	X^2	**P – value** ($p \leq 0.05$)
Doctors	88	12	0	15	0.36
Nurses	52	40	8		
Allied Health Workers	48	32	20		
Administrative staff	21	52	27		
Unskilled workers	9	18	73		

Table 5: Distribution of HBsAg and HCV screening and vaccine uptake among healthcare workers

Occupation	**Screening (100%)**	**Vaccination (100%)**
Doctors	100	93
Nurses	100	91
Allied health workers	78	72
Administrative staff	67	55
Unskilled workers	37	21
X^2	11.3	15.0

p- value ($p < 0.05$)	0.26	0.24

4.0 Discussion

4.1 Sex distribution of HCWs in the healthcare centers

A higher number of females healthcare workers enrolled for the study than the male HCWs. This is similar to the study conducted in Mozambique with an enrollment of a higher population of females than male healthcare workers (Mabunda *et al,* 2022).

4.2 HBV and HCV seroprevalence among HCWs

The overall seroprevalence of HBsAg and HCV among HCWs in this study was 13.0% and 2.8% respectively. The seroprevalence of 13.0% obtained for HBsAg in this study is close to the national prevalence range of 12.20% (Olayinka *et al.,* 2016) but higher than a national pooled prevalence of 9.5% HBV infection in Nigeria (Ajuwon *et al.,* 2021) Likewise, a lower seroprevalence of 2.9% was obtained among healthcare workers in a tertiary hospital in Rwanda and 5.7 % among surgical and non- surgical healthcare workers in Tanzania (Shao *et al,* 2018). The lower prevalence of HBsAg and HCV obtained among the clinical staff compared to the non-clinical staff is similar to the findings of Orji *et al.* (2020), where 60% prevalence was found among the administrative staff. The HBsAg prevalence among healthcare workers in this study aligns with the WHO standard for HBV endemicity at ≥ 8% high, 2-7% moderate and < 2% low (Ott *et al.,* 2012). Work place exposure to HBsAg infection is a well-proven hazard for healthcare workers due to the degree of exposure of the worker to blood and body fluids of the patient (Singhai *et al.,* 2011).

Data obtained on HCV in this study is at variance with other findings which can be ascribed to variations in the sample size and exposure level of healthcare workers tested. The HCV seroprevalence was higher than the 1.2% seroprevalence of HCV infection among healthcare workers in a Medical Centre in Tanzania and 1.3% prevalence in a Rwandan Tertiary hospital (Mueller *et al.,* 2015; Kateeraa *et al.,* 2015). Variations in HBsAg and HCV seroprevalence observed across the various countries in Sub-Saharan Africa compared to our results may be due to differences in socio-economic status, healthcare systems, educational levels, awareness of HBsAg and HCV infection prevention and control practices, occupational risks exposures, distribution of diseases among the general population.

4.3 Knowledge and awareness of HBsAg and HCV among HCWs

The poor knowledge of HBsAg and HCV infection exhibited by unskilled workers suggests that the level of awareness and knowledge of viral hepatitis, especially among poorly educated personnel, remains a source of apathy which might account for the high seropositivity among them compared to other cadres of healthcare workers tested. These variations in seroprevalence of HCV was evident across all the cadres. The 50% good knowledge of HBsAg and HCV among Allied health workers is quite disturbing as the group comprises the Medical Laboratory Scientists and Pharmacists who have undergone formal training on Infection prevention and control (IPC). Quite a number of unskilled workers and the administrative staff are not well informed or have poor knowledge of viral hepatitis and its mode of transmission. On the other hand, a good knowledge and awareness of viral hepatitis exhibited by doctors (88%) and Nurses (52%) agree with the study conducted in Usman Danfodio University Teaching Hospital, Sokoto State, Nigeria with 86.3% awareness for doctors, nurses and Allied health workers (Hassan *et al.,* 2021). Lack of formal training on infection prevention and control among non-clinical staff and posting to high -risk areas often expose them to bloodborne pathogens including hepatitis B and C with inadequate knowledge of handling such infections.

4.4 Vaccination coverage of HBsAg and HCV among HCWs

While it is expected that all individuals who are hepatitis B negative should be vaccinated and those who are hepatitis B positive receive the treatment, it was found that not all participants who are hepatitis B negative have received hepatitis B vaccination. The uptake of hepatitis B vaccination among unskilled healthcare workers in Karu, Nigeria was poor at 21%. This is quite disturbing, particularly among the ward attendants who work closely with clinical staff as it is expected that constant exposure to infectious diseases should spike the knowledge of taking adequate precautions including HBsAg vaccination by these categories of workers. The number of clinical and nonclinical staff who have not been vaccinated portends a public health risk of contracting HBV and transmitting HBV to other patients and family members. A higher percentage of the doctors, nurses and allied health workers had a higher hepatitis B vaccine uptake than administrative staff and unskilled staff. Kisangau *et al.* (2017) reported a higher percentage of vaccine uptake among clinical staff than non-clinical staff in Kenya. This higher uptake of hepatitis B vaccine among the clinical than administrative staff could have resulted from their pre-employment training and education on infection prevention and control (IPC) underpinning their understanding of the importance and safety of hepatitis vaccination to health. However, the coverage of HBV vaccination among the doctors and nurses at 93% and 91%, respectively is below the World Health Organization standard of 100%. The lack of IPC formal training for unskilled staff could account for the poor knowledge of HBsAg and HCV in the three centers sampled. Positive indicators of HBsAg and HCV negative status were screening and vaccination against HBsAg and HCV infections.

It has been proven that prevention of any disease is directly proportional to knowledge, attitude and practice and therefore negligence during the handling of infected blood and blood products, and body fluid will be reduced with good and effective knowledge. It is, however, possible from this study and previous studies (Ya'aba *et al.,* 2019) that prevalence rates of HBV may differ across societies or communities in Nigeria because of differences in occupational risk exposure. Standard precautions and positive attitude towards standard precautions may have contributed to the slightly lower value obtained from this study.

4.5 Limitations of the study

The study relied on data obtained from self -vaccination status. Cronbach's alpha reliability metrics was not used for pilot test of reliability for 10 participants. Multivariate analysis was not tested to adjust for cofounders in sociodemographic data. Potential rapid test inaccuracies may result from the use of rapid test kits. Polymerase chain reaction was not performed for positive samples of HBsAg antibody and anti- HCV to determine the level of HBV viremia.

5.0 Conclusions

The study presented a seroprevalence data on hepatitis B and C infections among healthcare workers in three medical centres in Karu local government, Nasarawa State, Nigeria and found a high level of HBsAg endemicity and low prevalence of HCV amongst healthcare workers. The knowledge base, screening for HBsAg and HCV infections and vaccine uptake of HBsAg were particularly low among the unskilled HCWs. Continuous professional development programme for healthcare workers is critical as a reminder of best practices in healthcare settings and vaccination as a prevention strategy. The training should be inclusive of non-clinical staff in such centers, if Nigeria is to achieve the World Health Organization goal of eliminating hepatitis in 2030. Regular training is required to enable workers adhere to operational guidelines. Due to occupational health hazard encountered by healthcare workers on daily basis, it is recommended that the Ministry of Health should implement a mandatory vaccination policy for HCWs in Karu Local government, Nasarawa State, Nigeria.

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