■ ORIGINAL PAPERS

Percutaneous venepuncture practice in a large urban teaching hospital

Mark A Little, Tanya Hussein, Mark Lambert and Stuart J Dickson

ABSTRACT – Occupational exposure to blood-borne pathogens remains an important and largely preventable issue in hospital practice. This article argues that formal training can increase use of best practice phlebotomy. A survey of at-risk healthcare workers at a central London hospital was conducted to identify factors associated with use of an evacuated blood collection system (BD Vacutainer®) and gloves while taking blood. Eighty per cent of doctors and 37% of non-doctors performing percutaneous venepuncture did not use the Vacutainer system exclusively. Doctors qualified less than three years were particularly likely to prefer needle and syringe. Venepuncture technique training significantly increased the probability of always using the Vacutainer system from 7% to 46%. The only factor independently associated with glove use was operator experience. There is considerable room for improvement in phlebotomy technique, particularly among junior doctors. The Modernising Medical Careers initiative provides a unique opportunity to implement this.

KEY WORDS: occupational health, phlebotomy, post-exposure prophylaxis, training, Vacutainer, venepuncture

Introduction

In 1998, the Department of Health described the responsibilities of healthcare workers (HCWs) and employers in reducing and managing the occupational risk of exposure to blood-borne viruses.[1] In 2005, the Health Protection Agency (HPA) published details of significant occupational exposures reported to its enhanced surveillance system and occurring between 1996 and 2004.[2] In the HPA study, exposures involving nursing and medical professionals accounted for 45% and 37% of reported incidents respectively. Percutaneous injuries accounted for 78% of exposures, 63% of which involved hollow-bore needles. Percutaneous venepuncture was the most commonly cited individual procedure undertaken by HCWs that resulted in a significant occupational exposure to blood-borne viruses. Failure to comply with standard precautions was described as a significant contributory factor in 38% of exposures.

While general awareness of the hazard posed by exposure to blood-borne viruses during routine clinical duties is high among HCWs, this may not always be successfully translated into safe practice. Despite adequate provision of protective gloves and the universal availability of an evacuated blood collection system (BD Vacutainer®) throughout all clinical areas of our institution, the authors, on casual observation, noted a significant number of percutaneous venepuncture procedures being performed by HCWs without gloves or the BD Vacutainer® system (a vacuum tube blood evacuation collection system engineered to minimise the risk of operator exposure to patient blood during percutaneous venepuncture). Best practice phlebotomy mandates due attention to minimising the risk of infection to the patient, ensuring timely and efficient collection of blood samples, minimising risk of needlestick injury in the operator and up-to-date knowledge of the infectious consequences and correct actions to take in the event of such an injury. Incorporation of evacuated blood collection systems into phlebotomy practice is an important component of this approach.

A prospective survey of HCWs at a central London teaching hospital was undertaken and the use of gloves and the BD Vacutainer® system during routine clinical practice was studied. It was hoped this would test the theory that best practice venepuncture techniques were influenced by occupation, experience and formal training.

Methods

The University College London Hospital is a 660-bed teaching hospital. During January 2006, staff employed in the accident and emergency department (A&E) and the acute admissions unit, who routinely performed percutaneous venepuncture, were observed. A questionnaire was developed to capture data on occupation, place of work, time since attaining professional qualification, frequency of performing percutaneous venepuncture, training received, preferred venepuncture technique, use of gloves when performing venepuncture, number of sharps injuries (SIs) suffered and number of SIs

Mark A Little[1] PhD, Senior Lecturer

Tanya Hussein[2] MB, Foundation Year 1

Mark Lambert[2] MB, Foundation Year 1

Stuart J Dickson[2] MRCP, Specialist Registrar

[1]Division of Immunity and Infection, University of Birmingham
[2]Hospital of Tropical Diseases, University College London Hospital

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reported. The annualised SI rate was calculated from the number reported and the length of time that the individual had been routinely involved in taking blood. The questionnaire was distributed to HCWs routinely performing venepuncture in the target areas. Fifty-three responses were received, giving a response rate of 76%.

Table 1. Breakdown of study subjects according to site of operation and occupation.

		Frequency	Percentage (%)
Site of operation	Medicine	33	62.3
	Surgery	8	15.1
	A&E	10	18.9
	More than one	2	3.8
Occupation	Doctor	34	64.2
	Nurse/HCA	19	35.8
Venepuncture training	Formal	39	73.6
	Apprenticeship only	14	26.4

A&E = accident and emergency; HCA = healthcare assistant.

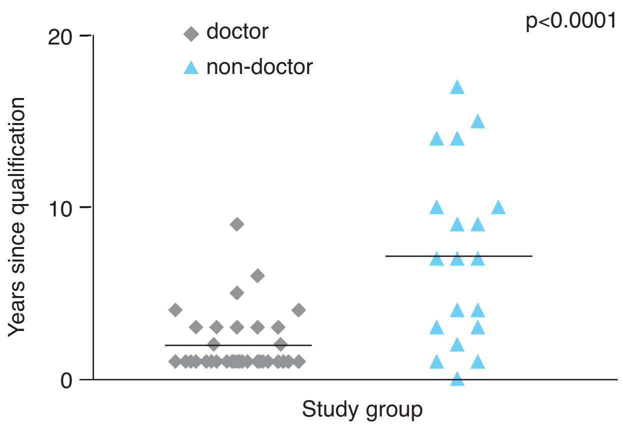

Fig 1. Comparison of duration since qualification in doctors and non-doctors. Mann-Whitney test.

Table 2. Phlebotomy technique and glove use among respondents.

		Frequency	Percentage (%)
Phlebotomy technique	Always Vacutainer	19	35.8
	Mixed usage	29	54.8
	Always needle and syringe	5	9.4
Glove use	Always	38	71.7
	Sometimes	12	22.6
	Never	3	5.7

Statistical analysis

Univariate analysis of categorical variables was performed using the Chi-square test. Univariate comparison of means was performed with the Mann-Whitney U test. As many of the variables studied are likely to have interdependent confounding effects on the outcomes measured, we performed multivariate analysis. For dichotomous dependent variables (impact of formal training), we used logistic regression. For non-dichotomous and continuous dependent variables, we used multivariate linear regression. All analyses were performed using SPSS 8.0 or Graphpad Prism 3.0.

Results

Description of dataset

The characteristics of the subjects studied (n=53) are summarised in Table 1. Doctors (foundation year 1 and senior house officer grade) comprised 64% of the HCWs, the remainder being nurses (32%) and healthcare assistants (4%). Most of the study group worked in the medicine directorate, with approximately one third working in surgery or A&E. This was a relative under-representation of surgical teams, as it was difficult to obtain their completed questionnaires. Of those studied, 74% had undergone formal venepuncture training (24% clinical skills workshop, 19% training day and 13% had attended both). The median duration since qualification was two years (range: 0.5–17 years) and doctors were qualified for a shorter period than non-doctors (median 1 year *v* 7 years, p<0.0001, Fig 1).

Percutaneous venepuncture practice

BD Vacutainer® use was common in the study group, with 92% reporting at least some use (Table 2). Only 36%, however, reported using a Vacutainer all the time with 64% reporting needle and syringe use at least sometimes. The reason given for preference of a non-Vacutainer approach was usually that it was easier for patients with difficult venous access (n=12) or that the absence of a flashback made venepuncture more difficult (n=5). Other reasons given were that needle and syringe were less painful for the patient (n=2), they were easier to handle (n=2), there was a better selection of needle size (n=1) or they were simply out of habit (n=1).

With respect to glove use while taking blood, 72% reported always using gloves (Table 2), with most of the remainder reporting intermittent glove use. The principal reasons for choosing not to wear gloves were a perception of reduced manual dexterity (n=12) or that gloves were only needed for high-risk patients (n=5). Only one respondent felt that glove use did not provide protection against needlestick injury.

Factors influencing use of best practice

As the various factors potentially associated with best practice (BD Vacutainer® and glove use) are interrelated, we performed a multivariate linear regression analysis to identify independent associations. Thus, we controlled for potential confounding variables.

BD Vacutainer® use. The only factors independently associated with Vacutainer use were whether the respondent was or was not a doctor (p=0.001) and whether they were receiving formal training (p<0.01, Fig 2). It appears that there is a culture of high Vacutainer use among non-medics (63% always use Vacutainers), whereas only 20% of doctors reported using Vacutainers all the time. There was a trend towards BD Vacutainer® use among more experienced practitioners and in those working in the A&E department (Fig 2). There was a trend towards lower Vacutainer use in the surgical department. The number of procedures performed per week (p=0.9) was not associated with Vacutainer use (data not shown).

Glove use. The only factor independently associated with glove use while taking blood was the level of experience of the operator. There was a clear association between increased glove use and duration since qualification (Fig 3). The group reporting occasional or no use of gloves was virtually confined to those qualified less than three years. There was no independent association between glove use and whether the respondent was a doctor (p=0.7), the site of working (p=0.7), the number of procedures performed per week (p=0.6) or whether formal training had been undertaken (p=0.8).

Impact of formal training

Virtually all non-doctors had received formal training in percutaneous venepuncture, whereas 38% of doctors had been taught venepuncture techniques by apprenticeship alone (Fig 4). To eliminate the impact of confounding variables on the impact of formal training (defined as either clinical skills workshop or attendance at a training day), we performed a multivariate logistic regression analysis.

BD Vacutainer® and glove use. Formal training increased the probability of always using a Vacutainer from 7% to 46%, and decreased the probability of never using one from 14% to 5% (Fig 2). Formal training, however, had no impact on whether gloves were used while taking blood (Fig 3).

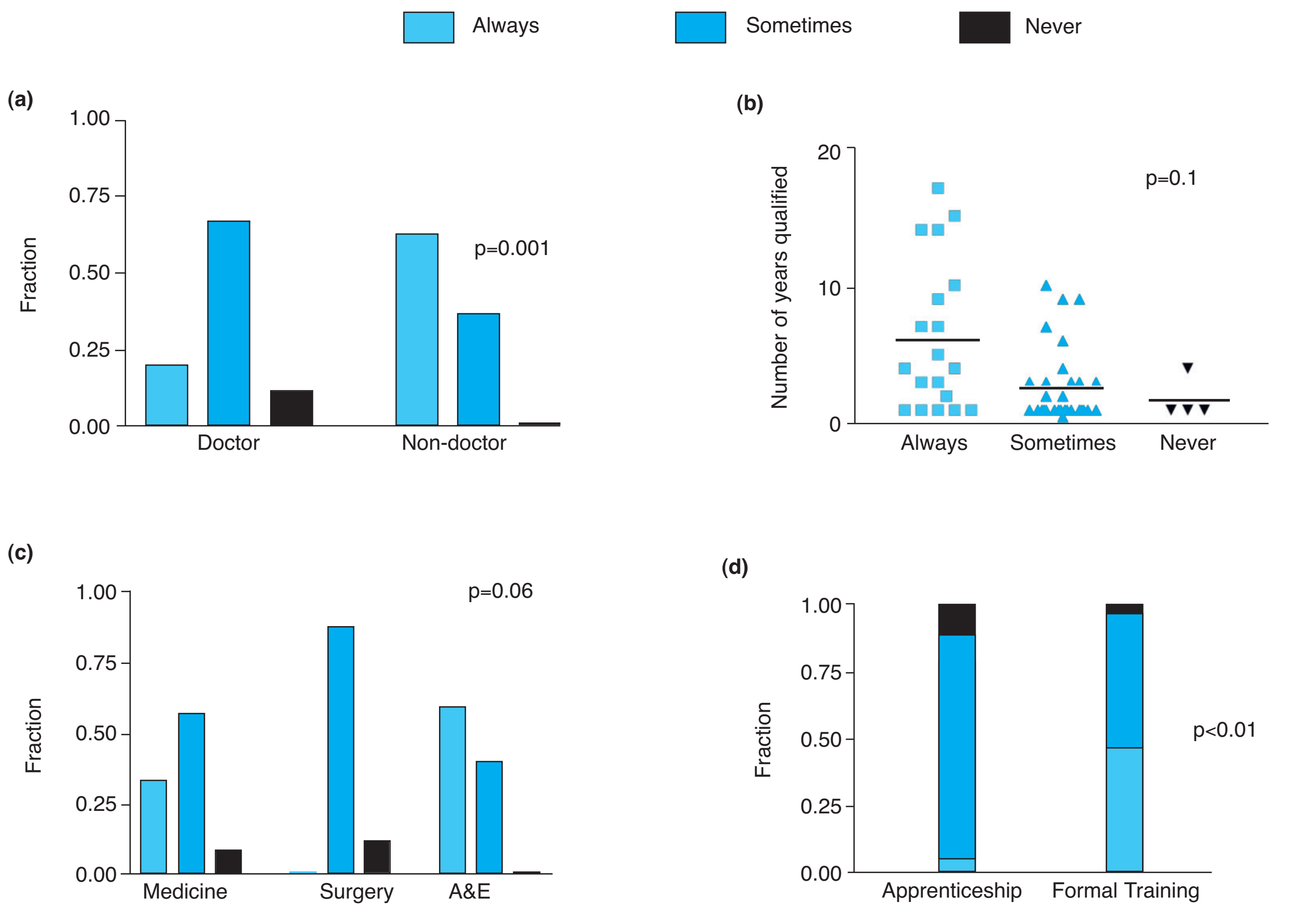

Fig 2. Comparison of BD Vacutainer® use among doctors and non-doctors (principally nurses) (a); according to the number of years qualified (b); according to the location within the hospital (c); according to whether or not formal training had been undertaken (d). Multivariate linear regression (a,b,c) and multivariate logistic regression (d).

Impact of formal training on knowledge of sharps injury protocols. Formal training had no impact on knowledge of when or where to seek advice following a SI, or whether post-exposure prophylaxis was available for hepatitis B, hepatitis C or HIV (Figs 5 and 6).

Factors impacting on sharps injury rate

The overall mean SI rate was 0.37 episodes per year (95% confidence interval 0.2 to 0.5). Using this as a continuous variable, we performed multivariate linear regression analysis to identify independently associated factors.

The only variable independently associated with SI rate was the level of experience of the operator ($p<0.05$, Fig 7). Beyond five years after qualification, the rate of SI dropped to a very low background rate of approximately one episode every five years.

Whether the respondent was a doctor or non-doctor, or whether or not they used a BD Vacutainer®, had no effect on reported SI rate (Fig 7). Additional variables with no significant independent association with SI rate on multivariate analysis were the location in the hospital ($p=0.3$), the number of procedures performed per week ($p=0.9$) and whether or not formal training had been undertaken ($p=0.7$).

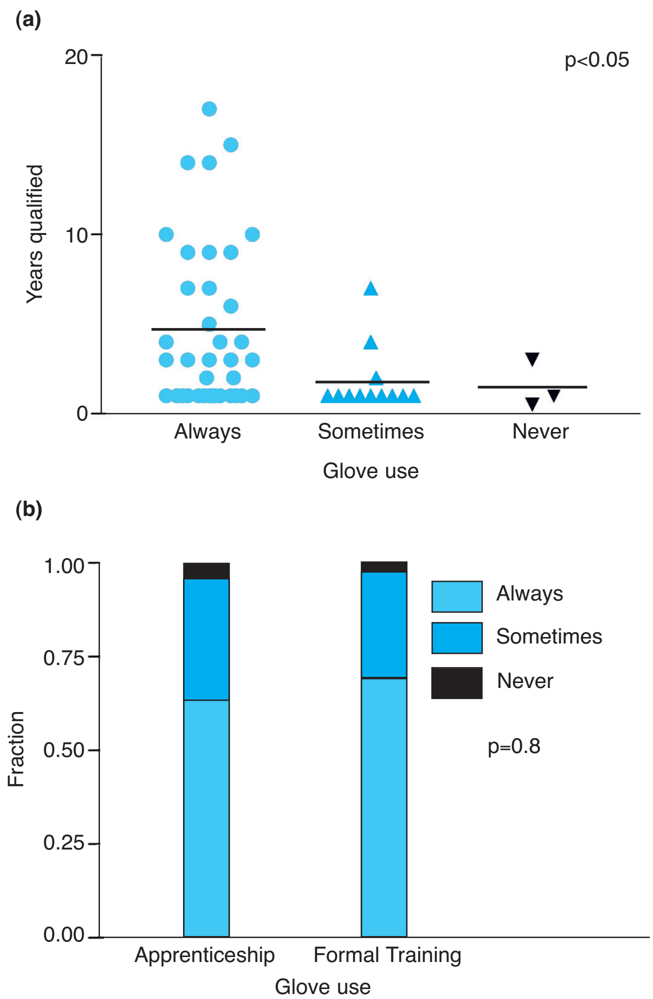

Fig 3. Comparison of glove use according to the level of experience of the respondent (a) and according to whether or not formal training had been undertaken (b). Multivariate linear (a) and logistic (b) regression.

Discussion

The National Institute for Health and Clinical Excellence (NICE) has acknowledged the paucity of published evidence for the reduction of needlestick injuries attributable to needlestick prevention devices and systems.[3] The clinical evaluation of such systems and devices is difficult for a number of reasons. Firstly, ascertainment of SIs is difficult due to widespread under-reporting. Secondly, data to calculate rates of SI attributable to various clinical procedures (ie the number of procedures performed and the equipment used) are not routinely available. And thirdly, a large number of procedures must be evaluated because of the relatively low rate of SI.[4] Despite these difficulties NICE has affirmed that such systems 'must be used where there are clear indications that they will provide safer systems of working for healthcare personnel'.[3] Although safety-engineered needle protection devices are not yet supplied to HCWs in all UK healthcare institutions, vacuum-tube blood evacuation systems are widely available. The use of such systems and devices (when provided), during percutaneous venepuncture is regarded as safest practice.

In this study, 80% of doctors and 37% of nurses and healthcare assistants performing routine percutaneous venepuncture admitted to not exclusively using the BD Vacutainer® system provided. In a study performed by the Centers for Disease Control and Prevention, a 66–76% reduction in percutaneous injuries sustained during phlebotomy was described in those who utilised vacuum tube blood collection devices.[4] The alternative needle and syringe method requires the operator to transfer the blood to a number of blood collection tubes by means of repeated puncture of each tube in turn, following successful venepuncture. This may mandate up to six or more individual punctures, in addition to the percutaneous venepuncture itself. Each puncture carries the risk of not only

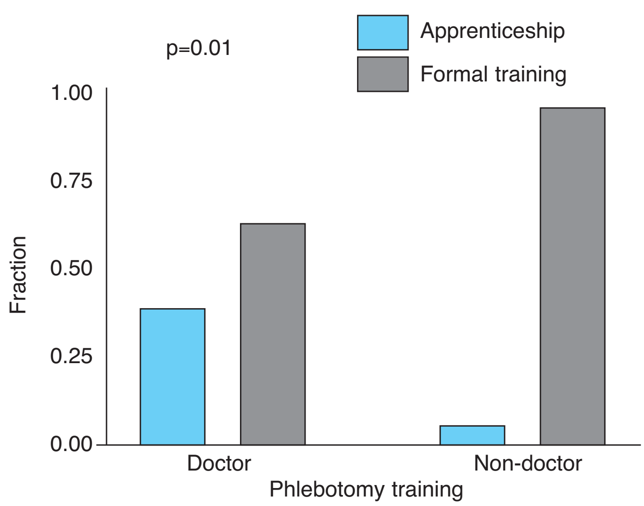

Fig 4. Probability of formal training according to occupation. Chi-square test.

accidental SI to the operator, but also of splash injuries. The degree of risk inherent in the use of a needle and syringe for percutaneous venepuncture is thus predictably greater than that when an evacuated blood collection system is used.

The most commonly cited reasons for preference of needle and syringe were related to the perception that their use was easier in patients with difficult venous access, and that operators found the presence of a flashback into the hub of the needle during venepuncture a particularly useful guide to performing a successful procedure. The reasons why HCWs prefer not to use the evacuated blood collection system available are not clear, but are likely to relate largely to a lack of formal training. Indeed, we identified that formal training in venepuncture technique in our hospital increased the probability of always using the BD Vacutainer® system from 7% to 46%. While formal training had a significant impact on technique, we could not detect any benefit with respect to glove use during venepuncture, or knowledge of SIs protocols.

The major factor contributing to the use of gloves was the level of experience of the HCW, measured by time since attaining professional qualification. Most worryingly, those admitting to no glove use at all or to only intermittent use were largely confined to those qualified less than three years. This reluctance to adopt standard precautions may relate to a number of factors including misconceptions about the utility of gloves in reducing the risk of blood-borne virus transmission; low perception of risk of acquisition of blood-borne viruses; age-related differences in engaging in risk-taking behaviours; and relative inexperience in performing clinical procedures (hence the operator might perceive themselves to be at risk of a failed venepuncture because of the lack of manual dexterity resulting from glove use).

In our study, the proportion of HCWs correctly recognising that post-exposure interventions were available for the management of hepatitis B and HIV infections, were 55% and 87% respectively. Additionally, 85% correctly identified that there are no interventions available at present following occupational exposure to hepatitis C. Of the study participants, 72% correctly identified that assessment and intervention following a SI should be undertaken within one hour to permit optimal post-exposure prophylaxis of HIV infection, in accordance with national guidelines.[5] While encouraging, these figures demonstrate a substantial number of individuals routinely performing percutaneous venepuncture within our institution are unaware of which post-exposure interventions are available and in what time frame they should ideally be instigated.

Our study showed no correlation between use of the

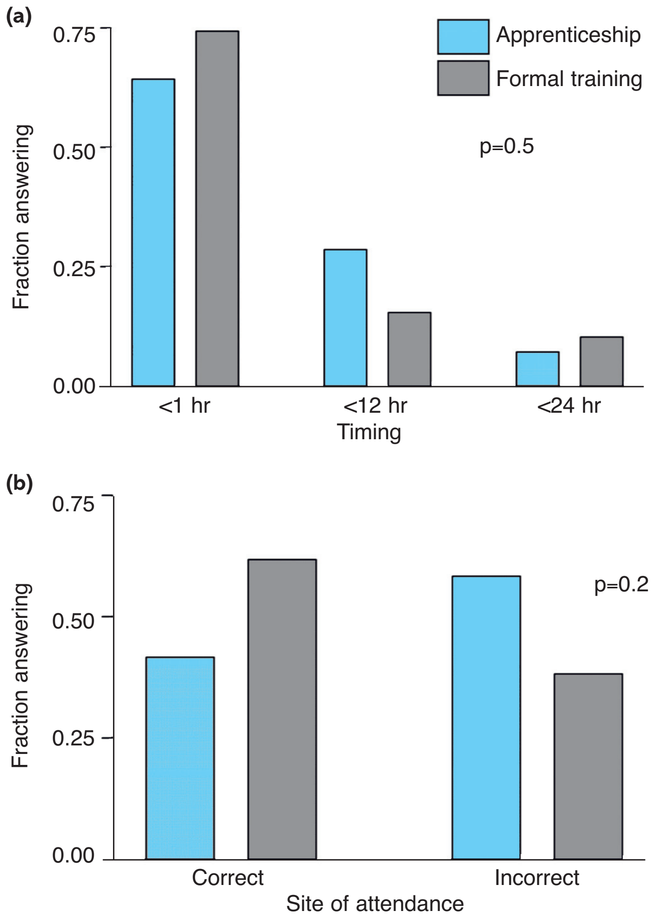

Fig 5. Comparison of knowledge of the timing (a) and site (b) of attendance for assessment following an injury causing potential occupational exposure to HIV, according to whether or not formal training had been undertaken. Multivariate logistic regression.

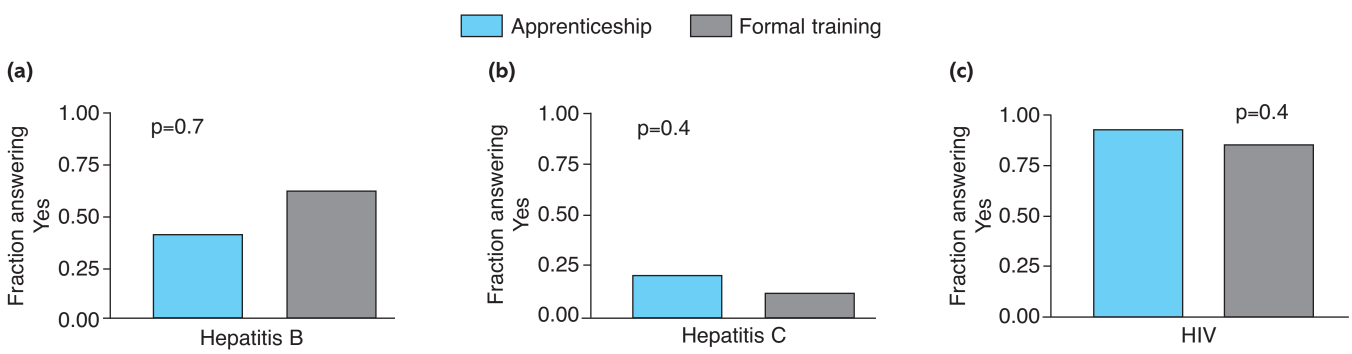

Fig 6. Comparison of knowledge of post-exposure prophylaxis availability following a sharps injury according to whether or not formal training had been undertaken. Multivariate logistic regression.

evacuation blood collection system and the rate of SIs sustained by HCWs. This is because the HCWs surveyed were asked to recall the number sustained, regardless of the mechanism of the injury. As the programme of surveillance of significant occupational exposure to blood-borne viruses performed by the HPA demonstrated, although percutaneous venepuncture was the most commonly cited clinical procedure resulting in exposure, it is still only responsible for 17% of SIs.[2] Many other clinical procedures involving the routine use of sharps may also result in injury to the HCW. Thus we would not expect our study to have the power to demonstrate any association between evacuation blood collection system use and needlestick injury rate. Our study highlighted an interesting association between the rate of SI and level of experience of the operator, with the rate of injury falling substantially in those five years or more beyond qualification. However, it is possible that alternative explanations such as recall bias, or the fact that junior staff perform a far greater number of clinical procedures than their senior colleagues, could explain the apparent increased risk of SI in those qualified less than five years.

Significant advances have been made in recent years in ensuring NHS trusts meet their legal obligations in respect of initiating a wide range of initiatives to improve the management and monitoring of health and safety risks to staff. NHS staff surveys, however, have found that employees are often unaware of the health and safety policies in place.[6] The responsibility of the individual healthcare worker to perform their clinical duties in a manner which optimally minimises the risk to both themselves and colleagues cannot be overstated.

In summary, this study suggests that HCWs may not always perform their duties in the safest manner possible. It appears that less experienced HCWs (particularly junior doctors) may be taking unnecessary risks when performing percutaneous venepuncture by failing to routinely use the safety-engineered blood collection system and personal protective equipment provided. This study suggests that formal training in percutaneous venepuncture results in higher uptake of the evacuation blood collection system and therefore safest practice. While nursing professionals have a more stringent system of ensuring competency and safety in performing clinical procedures, medical

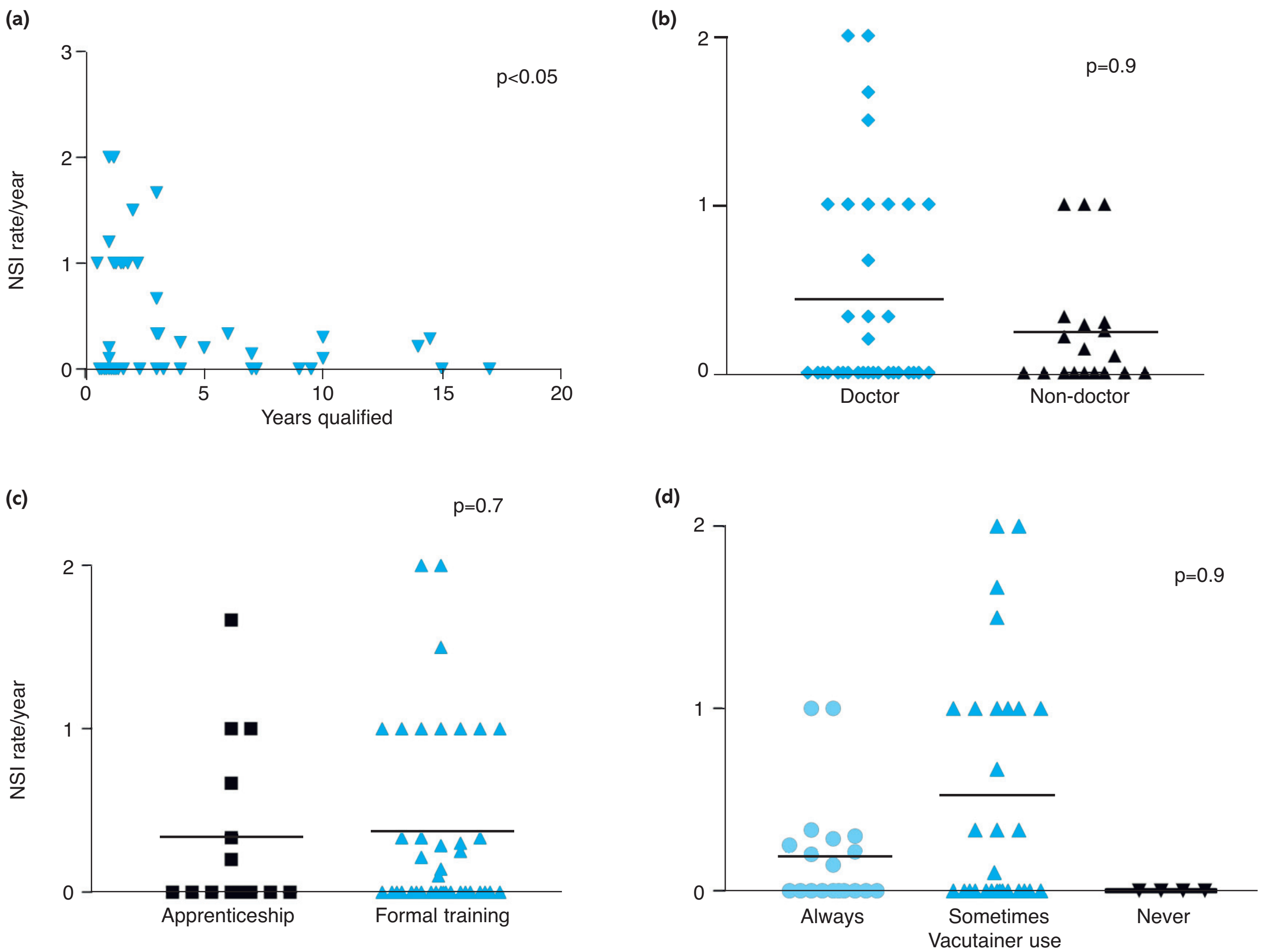

Fig 7. Impact on needle stick injury (NSI) of duration since qualification (a); whether the respondent was a doctor or non-doctor (b); whether or not formal training had been undertaken (c); and according to Vacutainer use (d). Multivariate linear regression.

professionals historically have not. The competency-based training to be introduced as a key element of Modernising Medical Careers offers the ideal opportunity to ensure the future generation of doctors are aware of the risks they face in their professional lives and that they are trained to perform their clinical duties while being mindful of those risks.[7]

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