Venepuncture technique training *vs* practice: a survey of foundation year 1 doctors

This survey investigated potential disparity between foundation year 1 doctors' formal undergraduate venepuncture training and their actual clinical practice. Is there still a high prevalence of needle and syringe use?

In November 2006 the Health Protection Agency reviewed data collected between 2002 and 2005 regarding UK health-care workers' exposure to blood-borne viruses. Their report concluded that the number of occupational exposure incidents had increased by 49%. The most common source of exposure was percutaneous injury with a hollow bore needle, which increased by 46%.

The single biggest group of health-care workers involved in exposures were doctors, and between 1 January 1997 and 31 December 2005 their exposure increased by 78% (Health Protection Agency, 2006). The report documents eleven cases of hepatitis C and five cases of human immunodeficiency virus (HIV) seroconversion between 1996 and 2005 in UK health-care workers (Health Protection Agency, 2006). This increasing trend of percutaneous injuries, compounded by doctors' risk of exposure, is truly worrying. The debate must now focus on identifying and addressing causes for these increases.

In the face of this trend in needlestick injuries, guidance and law is continually evolving. The Health and Safety at Work Act 1974 detailed an employer's duty of protection to employees while undertaking their daily work, but did not specifically refer to needlestick injuries. Thus specific and detailed policy was formulated and written into the statute book. The 2003 Needle Stick Bill, an amendment to the 1974 act, details the responsibilities of NHS trusts with regards to needlestick injuries specifically. Trusts must maintain records of all injuries and provide suitable equipment likely to reduce the risk of needlestick injuries. This bill of amendment for the first time recognizes that failure in a NHS trust's duty can be seen and treated as an offence. From the statute book, the Scottish courts ruled in 2004 that cost should not be a consideration when purchasing safer sharps devices.

The recently updated national evidence-based guidelines for preventing health-care-associated infections in the NHS commissioned by the Department of Health recommends consideration of the use of needlestick prevention devices (Pratt et al, 2007). This advice follows a growing body of evidence that needlestick prevention devices have a significant impact on injury rates (Cullen et al, 2006).

Routine venepuncture is a primary task undertaken by junior doctors on the ward. The techniques used for venepuncture include the evacuated blood collection systems and needle and syringe. Examples of evacuated blood collection systems include the Vacutainer (BD, Oxford, UK), Monovette (Sarstedt, Nümbrecht, Germany) and the Vacuette (Greiner Bio-one, Kremsmünster, Austria) systems. Vacuum blood tubes are the final container of any collected blood and the predetermined vacuum within the tube ensures the appropriate volume of blood is collected. Using the needle and syringe technique requires the potentially repeated transferring of collected blood into different blood collection tubes, leaving the operator at risk of needlestick injuries or blood splash.

A multicentre prospective study of the risk of transfer of blood-borne viruses to health-care workers showed the use of needle and syringe to be associated with 44% of all needlestick injuries while evacuated blood collection systems were responsible for 5% (Ippolito et al, 1999). Furthermore, a Centers for Disease Control study in the USA showed that the use of an evacuated blood collection system was associated with a 66–76% decrease in needlestick injuries when compared to needle and syringe (Centers for Disease Control and Prevention, 1997). For this reason, medical students at St George's, University of London receive formal venepuncture training in evacuated blood collection system (Vacutainer) exclusively.

In September 2005, anecdotal reports from third year medical students at St George's, University of London suggested a disparity between their formal venepuncture training at medical school and the actual clinical practice of junior doctors on the wards.

To investigate their concerns, the authors conducted a pilot survey in March 2006 at St George's Hospital, Tooting. Of foundation year 1 (FY1) doctors surveyed in the pilot 91% reported using a needle and syringe for routine venepuncture on a patient with normal average veins. A study at another central London hospital found a similar rate of needle and syringe use among junior doctors (Little et al, 2007). The pilot data highlighted the need to further investigate the reasons for this high prevalence of needle and syringe use among FY1 doctors.

In this multicentre survey of five south-west London NHS teaching hospitals, junior doctors were surveyed via a simple questionnaire. Their standard venepuncture technique preferences were investigated and common reasons and trends for their behaviour were identified.

Methods

The survey focused on all FY1 doctors in five teaching hospitals in south-west London. The hospitals included were spe-

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cifically selected because they serve as the main five teaching hospitals for St George's, University of London medical students. FY1 doctors were chosen as they frequently perform venepuncture, had recent medical school training in venepuncture and have regular contact (as role models and teachers) with current medical students on wards.

The survey was designed to explore current practice and awareness across the different hospitals. The number of FY1 doctors working on each hospital site was provided by the postgraduate training office of each hospital. The demographic and qualitative data were collected using a short anonymous questionnaire during June 2007. June was chosen as all FY1 doctors would have been in the role for 11 months and therefore should have established their routine venepuncture technique.

Each FY1 doctor completed the questionnaire during weekly protected teaching time. This setting was chosen since it was away from the ward and allowed respondents to answer without interruption or possible influence. A 4-week sampling period was used to enable maximum participation of FY1 doctors. Each hospital site had a dedicated researcher responsible for circulating and collecting questionnaires. An identical questionnaire was used at each hospital site.

The following areas were explored in the questionnaire: routine method of venepuncture on a patient with 'normal average' veins, awareness of safe venepuncture techniques when taking blood cultures or taking blood after insertion of an intravenous cannula, venepuncture technique formally taught at medical school and the particular technique they would teach medical students attached to their ward or firm. If needle and syringe was the preferred venepuncture technique, they were asked to provide reasons for this. The reasons listed in the questionnaire were developed from the results of the pilot survey conducted at St George's Hospital in 2006. A free text box was included to allow further reasons to be added. A copy of the questionnaire is available from the corresponding author. The findings from all hospitals were consolidated and compared to provide an overall picture of venepuncture practice among newly qualified doctors in south-west London today.

The Vacutainer system was the evacuated blood collection system in use across all the hospital sites surveyed. Thus where reference is made to evacuated blood collection system in this paper, it should be taken to denote the Vacutainer system.

In addition to the questionnaire, a survey of evacuated blood collection system equipment stock levels was carried out on all the wards in each of the five hospitals. Stock levels of the following essential evacuated blood collection system components were checked; standard barrels (*Figure 1a*) and green screw-on needles (*Figure 1b*) for routine venepuncture, large barrels for blood culture (*Figure 1c*), and blue screw-on 'Luer' adaptors (*Figure 1d*) to take blood through newly inserted intravenous cannulae and to use butterfly needles. The results from the ward stock survey were then compared to the relevant responses from the questionnaire to ascertain if this was a contributing factor to the choice of venepuncture method.

The authors contacted all the UK medical schools from which the respondents had graduated to establish which method of venepuncture they formally teach.

Results

Respondents

Of the 136 FY1 doctors based at five NHS hospitals, 74% (n=101) answered the questionnaire. Of the 101 respondents, 67% trained at St George's, University of London. *Table 1* gives a full breakdown of the medical schools which respondents had attended.

Figure 1. Different components of the Vacutainer system. a. Standard barrel. b. Standard green needle. c. Large barrel for blood cultures. d. 'Luer' adaptor fitted to a standard barrel.

Table 1. Medical schools represented by respondents

Medical schools represented	
St George's, University of London	69 (68%)
Other London medical schools	12 (12%)
Other UK medical schools	8 (8%)
Other not declared medical schools	8 (8%)
Other non-UK medical schools	3 (3%)
Not completed question	1 (1%)
Total	101 (100%)

Formal training at medical school

Of respondents, 64% stated that they had been taught the use of an evacuated blood collection system exclusively, 25% said they had been taught both needle and syringe and the evacuated blood collection system while 9% of respondents claimed to have been formally taught only the use of needle and syringe for venepuncture.

On contacting the medical schools that trained the UK graduates in the survey, all but two reported that they only formally teach the use of an evacuated blood collection system (in particular the Vacutainer system) in their undergraduate curriculum. This represents 98% (95/97 UK graduates) of respondents. Of the two other medical schools, one has devolved venepuncture training to its associated teaching hospitals and the other one teaches use of both an evacuated blood collection system and needle and syringe.

Routine venepuncture

A total of 80% stated that for routine venepuncture they use a needle and syringe, and 90% go on to use a syringe to collect blood after inserting an intravenous cannula. Of FY1 doctors questioned, 70% claimed to use a needle and syringe when collecting blood cultures (*Table 2*).

Reasons

The top three reasons for using needle and syringe for blood sampling were 'ease of use' (70%), getting 'flashback' (49%), and unavailability of evacuated blood collection system stock on the wards (41%) (*Table 3*).

Needle and syringe practise

Of respondents, 80% admitted to transferring blood from a syringe to the specimen bottle by directly forcing the needle through the rubber top of an evacuated blood collection system bottle, while 5% of respondents stated that they remove both the needle from the syringe and the bottle's lid, directly express blood into the bottle and then secure the lid back on.

Awareness

A total of 31% of respondents were unaware that the evacuated blood collection system can be used to collect blood through an intravenous cannula, while 27% did not know that the evacuated blood collection system could be used to take a blood culture sample.

Teaching of medical students

When asked how they would train medical students on their firm, 16% of respondents reported they would exclusively teach the evacuated blood collection system to students, 36% stated they would only teach needle and syringe, and 49% said they would teach both.

Ward stock audit

Across all sites the wards were inconsistently stocked. Of 106 wards audited, 85% stocked standard evacuated blood collection system barrels, 88% had standard needles, 40% stocked blue Luer connectors and 5% stocked large evacuated blood collection system barrels suitable for blood culture bottles (*Table 4*).

Discussion

Eighty per cent of the FY1 doctors surveyed admitted to using a needle and syringe for routine venepuncture, with only 9% stating that they had had formal training in its use. Alarmingly, 70% of respondents reported using a needle and

Table 2. Questionnaire results

What is your usual method of doing venepuncture? (assuming normal veins)	Needle and syringe	81 (80%)
	Vacutainer system	20 (20%)
What is your usual method of taking a blood sample after you have sited a cannula?	With syringe	91 (90%)
	With Vacutainer system	10 (10%)
What is your usual method of taking a blood culture?	Needle and syringe	70 (70%)
	Vacutainer system	30 (30%)
Are you aware that the Vacutainer system can be used to take blood through a cannula?	Yes	70 (69%)
	No	31 (31%)
Are you aware that the Vacutainer system can be used to take a blood culture?	Yes	74 (73%)
	No	27 (27%)

Table 3. Reasons for needle and syringe use

Reasons	Respondents
I find it easier to use	70
I get a 'flashback' with needle and syringe	49
Lack of full range of the Vacutainer system equipment on the wards	41
I was taught (informally) to use only needle and syringe once I reached the wards	16
I was influenced by the practice of colleagues on the wards	16
It is less painful for the patient	13
Not confident with Vacutainer system	7
I was taught this method formally at medical school	4
Nobody else uses Vacutainer	2
It is what my senior colleagues prefer me to use	1

syringe for blood cultures, and would therefore place the needle directly through the rubber top of the culture bottle. This method of blood culture collection has repeatedly been shown to be associated with increased rates of needlestick injuries (McCormick and Maki, 1981; Ruben et al, 1983; McCormick et al, 1991; Yassi and McGill, 1991).

Needle and syringe is not recognized by any of the NHS trusts in which the FY1 doctors worked as venepuncture 'best practice'. The main reason given by respondents for using needle and syringe rather than the safer evacuated blood collection system was ease of use. This indicates that the venepuncture training received by medical students and FY1 doctors must improve in order to foster confidence and familiarity with the safer evacuated blood collection system methods.

Indeed, the knowledge gap is further highlighted by the 31% of respondents who were unaware that the evacuated blood collection system can be used to collect blood through an intravenous cannula and the 27% that did not know that the evacuated blood collection system could be used to take blood cultures. This implies that the training received by respondents was below the acceptable standard.

Nearly half of respondents (49%) preferred needle and syringe for routine venepuncture because it enabled the operator to see flashback (when the needle penetrates an engorged vein and blood appears in the needle hub, indicating successful infiltration of a vein). In fact, this can also be achieved by placing a needle on a Luer adaptor (*Figure 1d*) (BD, 2008a) or the use of the Vacutainer safety-lock collection system, commonly referred to as a 'butterfly' needle. In either case the safer evacuated blood collection system formats allow flashback to be observed while ensuring operator safety. Vacutainer also has a dedicated screw-on flashback needle (*Figure 2*).

This survey also identified that inadequate ward stocking at times prohibited the use of safe venepuncture techniques. Although most wards provided the key components of the evacuated blood collection system, most were missing Luer adaptors (*Figure 1d*) and/or large blood culture barrels (*Figure 1c*).

On careful analysis of the data pertaining to blood culture sampling, the actual blood culture bottle type that a particular hospital stocked most likely influenced the practice of the FY1 doctors. Of FY1 doctors who reported that they use the evacuated blood collection system to take blood cultures 73% (n=22) worked at a hospital which used a blood culture bottle whose neck fits into a standard Vacutainer barrel (*Figure 1a*). Conversely, at the other four hospitals the blood culture bottles do not fit a standard Vacutainer barrel and subsequently the majority (71%, n=71) of the FY1 doctors in these hospitals used needle and syringe to take blood cultures.

Of respondents 80% transferred blood from a syringe to a standard vacuum blood bottle by placing the needle directly through the rubber top of the bottle, a practice strongly associated with an increased risk of needlestick injuries (McCormick and Maki, 1981; Ruben et al, 1983; McCormick et al, 1991; Yassi and McGill, 1991). An alternative method used by 5% of respondents was to remove the vacuum bottle's top, as well as the needle, and gently express the correct amount of blood into the bottle, replacing the top firmly afterwards. However, this still exposes the operator to a potential splash risk. Furthermore, evacuated blood collection system tubes are not designed to be compatible with either practice because of increased risks of tube leakage, breakage and incorrect volume collection (BD, 2008b).

It is imperative that medical students and doctors are aware of the potential risks involved with unsafe venepuncture techniques. The fact that 36% of respondents stated that they would teach medical students on their firms to use just needle and syringe is extremely concerning. With a mere 20% (n=20) of FY1 doctors using an evacuated blood collection system themselves for routine venepuncture, it is not surprising that only 16% of FY1 doctors reported they would teach the use of an evacuated blood collection system exclusively to medical students. This suggests that there is the potential for unsafe venepuncture practice to be perpetuated through the teaching of FY1 doctors.

Although needle and syringe use is not formally taught by any of the UK medical schools the respondents graduated from, it appears the majority of FY1 doctors had learnt this technique in an ad-hoc, unverified and unassessed style. This is most concerning given the hazardous nature of venepuncture. It is up to medical schools and trust managers to ensure that this does not continue. NHS trusts have a duty of care under existing health and safety legislation to ensure that their employees are educated in the safe use of sharps (Health Protection Agency, 2006).

In order to change the potentially dangerous behaviour of FY1 doctors concerning venepuncture, some simple strategies could be implemented. First, ward stock needs to be fully maintained at all times, including the stocking of evacuated blood collection system wide barrels. This would allow blood cultures to be taken without a needle and syringe.

Table 4. Ward stock audit results

	Wards	Standard barrels	Large barrels	Green needle	Blue connectors
St George's	30	232 (77%)	0	24 (80%)	6 (20%)
Mayday	20	16 (80%)	0	17 (85%)	11 (55%)
Kingston	17	17 (100%)	n/a*	17 (100%)	10 (58%)
St Helier	21	17 (81%)	5	19 (90%)	12 (57%)
Epsom	18	17 (94%)	0	16 (88%)	3 (16%)
Total	106	90 (84%)	5 (4%)	93 (87%)	42 (40%)

*In Kingston Hospital a different type of blood culture bottle is used, which has a long, thin neck. This enables it to fit into the standard evacuated blood collection system barrel and negates the need for this hospital to stock large evacuated blood collection system barrels altogether.

Figure 2. Flashback needle on standard barrel.

Second, medical schools need to improve their training in venepuncture to ensure that medical students are confident in the use of the evacuated blood collection system, and the full flexibility of its use, e.g. ability to attach to intravenous cannuli and ways to obtain flashback. FY1 doctors should attend a compulsory refresher workshop upon starting work in order to ensure both that they are competent in the use of evacuated blood collection system and that they are aware of the health and safety implications of using needle and syringe. FY1 doctors must be made aware that it is dangerous to teach medical students unsafe venepuncture techniques. They should be actively encouraged to teach and role model the appropriate safe techniques.

This survey did not assess the current levels of needlestick injuries from the cohort surveyed. However, published literature correlates this behaviour to increased risk of needlestick injuries. Ward stock levels were assessed on one single stock check. Perhaps stock checks over a longer period would provide an idea of stock level fluctuations on wards.

The understanding of the term 'formal' training was not discussed with respondents. This is a possible reason why some FY1 doctors indicated they had received formal needle and syringe training when virtually all their medical schools denied it. This could have been clarified within the questionnaire. The three non-UK medical schools were not contacted about what formal venepuncture training they provide. This represented 3% of the respondents (n=3).

The 2006 Health Protection Agency report concluded that 38% of exposures could have been prevented if safe handling techniques had been used. Other studies have demonstrated similar behaviour with nurses and phlebotomy-trained health-care assistants (Little et al, 2007). However, reasons for this behaviour have not been investigated until now.

Reaction to survey results

The results of this survey have been communicated to the chief executives of all the NHS trusts involved. At St George's Hospital, the main teaching hospital, strong action has been taken by management to review and rectify ward stock supplies of the local evacuated blood collection system. FY1 venepuncture refresher workshops have been introduced to raise awareness and reinforce the use of safe techniques during venepuncture. St George's University of London has also upgraded its undergraduate teaching of venepuncture to include training in and raise awareness of the wider range of evacuated blood collection system uses. The authors are unaware of any changes at the other hospital sites.

Conclusions

These results demonstrate widespread unsafe venepuncture practice and a poor translation of education to practice. Perceived or actual stock levels can play a part in the decision-making process for doctors when taking blood.

This survey has demonstrated that a significant number of FY1 doctors are routinely using methods of venepuncture proven to be unsafe because of their correlation with needlestick injuries (Health Protection Agency, 2006). Reasons for this have been identified, the main one being ease of use. This emphasizes a need for improved medical student training to ensure that all those graduating from medical school are confident and competent in using evacuated blood collection systems. It is imperative that students are made aware of the full range of uses of the evacuated blood collection system.

Finally, it is up to the trust and ward managers to ensure that all wards and departments are adequately stocked with the full range of its evacuated blood collection system's equipment, otherwise they are placing their employees at unnecessary risk. **BJHM**

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KEY POINTS

- Dangerous health and safety risks are exposed and highlighted in this survey.
- There is a major discrepancy between venepuncture training and the actual practice of foundation year 1 doctors.
- Unsafe practice of foundation year 1 doctors is potentially perpetuated by medical students.
- Ward stock is a real problem on most wards surveyed.
- Foundation year 1 doctors find needles and syringes easier to use.