Blood Splattering from Safety Devices

Healthcare workers are at risk of biohazardous exposure on a daily basis. More specifically, laboratory personnel are at risk for needlestick injury (NSI) and exposure through aerosols and splatter. NSI resulting from a patient known to be infected presents a 0.5 to 30% risk of infection to the injured healthcare worker depending on the pathogen. Though hepatitis B and C as well as HIV present the most common threat, there are several other pathogens that can result in disease following a needlestick [1].

The Needlestick Safety and Prevention Act (NSPA) to revise the Occupational Safety and Health Administration 's (OSHA) standard regulating occupational exposure to bloodborne pathogens, including the human immunodeficiency virus, the hepatitis B, virus, and the hepatitis V virus, was signed into law in November 2000 and becoming effective in April, 2001 [2]. It mandated OSHA to publish its requirements to further reduce health care workers' exposure to bloodborne pathogens by imposing additional requirements upon employers, such as hospitals and ASCs, concerning their sharp procedures. Following, needlestick injury data collected in healthcare centres in the United States during 2001 revealed that 16% of all needlestick injuries reported were sustained from devices designed to take venous blood sample (Exposure Prevention Information Network (EPINet) 2001). This figure decreased to 11.5% by 2007 (EPINet 2007) [3].

Since the use of sharp safety devices is becoming increasingly important on the market studies were undertaken to evaluate such devices.
Safety-engineered blood collection devices are featured with safety shields or retractable needles in order to immediately cover the phlebotomy needle after retraction from the vein. The needle is pulled or pushed into a protective shield.

EU rules [4] on product safety ensure that only safe products are sold on the market. That legal framework specifically addresses the risk of needle stick injuries and sets out in an interpretation guideline [5] the specific requirements for so-called safety-engineered blood collection devices. It is stated that a safety-engineered device should not add any risks in comparison to a non-safety device. One of the risks which may be added due to the various designs of the safety mechanism of such devices is a risk of blood splattering during the activation of the mechanism.

Where do blood splatters come from?

Blood behaves not unlike spilled water droplets. The effectiveness of a safety-engineered device is often dependent upon the user even if specific instructions need to be followed on the proper technique required to ensure that the device functions as intended. Whenever splashes, spray, spatter, or droplets of blood or other potentially-infectious materials (OPIM) may be generated, employers are responsible for evaluating the need for personal protective equipment as already one blood splatter presents a real danger since it is known that infection can occur if mucous membranes are exposed to even minute amounts of blood. Most users may not even be aware that splatter or aerosolization has occurred and, therefore, would not seek prophylaxis to prevent potential infection following exposure.

Though methods for assessing splatter may differ slightly, there have been studies that demonstrate visible and/or measurable splatter from use and activation of safety devices.

One study was designed to evaluate the safety of retractable intravascular devices in terms of their potential to produce blood splatter. A method for measuring blood splatter designed by the research team measures blood splatter by placing filter paper around the retraction

mechanism of the device. The filter paper is weighed with an analytical scale before and after simulated use and activation of the safety mechanism to determine whether any measurable blood splatter occurred. This method was applied during the evaluation of 3 specific intravascular devices. The outcome was significantly measurable and visible splatter occurred (or "could be measured") with 2 of 3 of the devices tested [1].

Studies since have taken this type of evaluation further by looking at specific devices and the mechanism of activation.

A study conducted in the UK started out with a general evaluation of several devices, including assessment of splatter, and then narrowed the number to three for further testing based on results: BD Vacutainer® Eclipse™ Needle, Greiner Bio-One VACUETTE® QUICKSHIELD and the BD Vacutainer® Push Button Collection Set. With regard to splatter, the QUICKSHIELD performed best out of the three devices. The Push Button produced seven incidents of visible splatter, the Eclipse produced eight (two of these were considerable based on amount within a given area) and the QUICKSHIELD only two out of 20 activations [5].

The test was done by inserting the blood collection needle of the safety device into a solution of a blood substitute containing fluorescein dye and was drawn into the syringe by attaching the blood evacuation tube. The safety mechanism was then activated following the manufacturer's instructions. In each case, a piece of coloured paper was placed beneath the device. The paper and the investigator's gloves were subsequently carefully examined under ultraviolet light to detect fluid droplets. Twenty samples of each of the safety devices were subjected to this test [5].

One of the most extensive evaluations specifically addressing blood splatter looked at winged phlebotomy devices [6]. A total of 5 brands (Terumo, two from BD, Greiner Bio-One, Smiths Medical and Kendall) and 6 different blood collection sets (Surshield™ Safety Winged Blood Collection Set, Vacutainer® Push Button Blood Collection Set, Vacutainer® Safety-Lok™ Blood Collection Set, VACUETTE® Safety Blood Collection Set, Saf-T-Wing® Blood Collection and Infusion Set and Angel Wing™ Blood Collection Set respectively) were tested for both measurable and visible blood splatter. Various gauges and tubing lengths were included with 25 of each tested. Measurable splatter was assessed by placing filter paper 360° around the collection site. The filter was weighed before and after collection and activation of the safety engineered device. For visible blood splatter detection, the filters placed around the collection site, the tester's gloves, the device itself and a second filter used to wipe the device were observed for droplets.

Two of the devices produced measurable splatter: BD Safety-Lok and Smiths Medical Saf-T-Wing. The Smiths Medical device had one incident of measured splatter and the BD device had 15 instances and was the only device to have a statistically significant difference in filter weight post activation.

The frequency and percentage of occurrences of visible blood on the filter, gloves, device and filter used to wipe the device following activation varied (see Figure 1). Visible blood on the filter around the puncture site varied from 0% with the VACUETTE® Safety Blood Collection Site to 60 % with the BD Push Button. Blood on the gloves varied from 0% with the VACUETTE® device to 4% with both of the BD devices. Visible blood on the device occurred from 48% to 58% of the time with the Terumo, Smiths Medical and Kendall collection sets. At the extremes, the VACUETTE® device had no instances of blood on the device but the BD devices showed blood on the device 77% (Push Button) and 90.67% (Safety-Lok) of the time. As a result, when the devices were wiped with filters post activation, results ranged from 0% to 18.67% with the VACUETTE® device being the only blood collection set with 0% visible splatter once again. Throughout the study, the VACUETTE®

Blood Collection Set was the only device with no measurable or visible blood splatter making it the safest choice based on these results.

Because healthcare personnel must be aware of any and all exposures in order to seek the appropriate post exposure care, it is extremely important that the use of safety devices meant to protect them does not create an additional risk of infection. Picking the safest device for use should include consideration of splatter risk and assessment of studies such as those cited here. Additionally, especially with devices associated with greater incidence of splatter, the appropriate protective equipment, e.g. face shields or googles, gowns, etc., should be utilized to prevent exposure and potential infection with bloodborne pathogens.

Figure 1

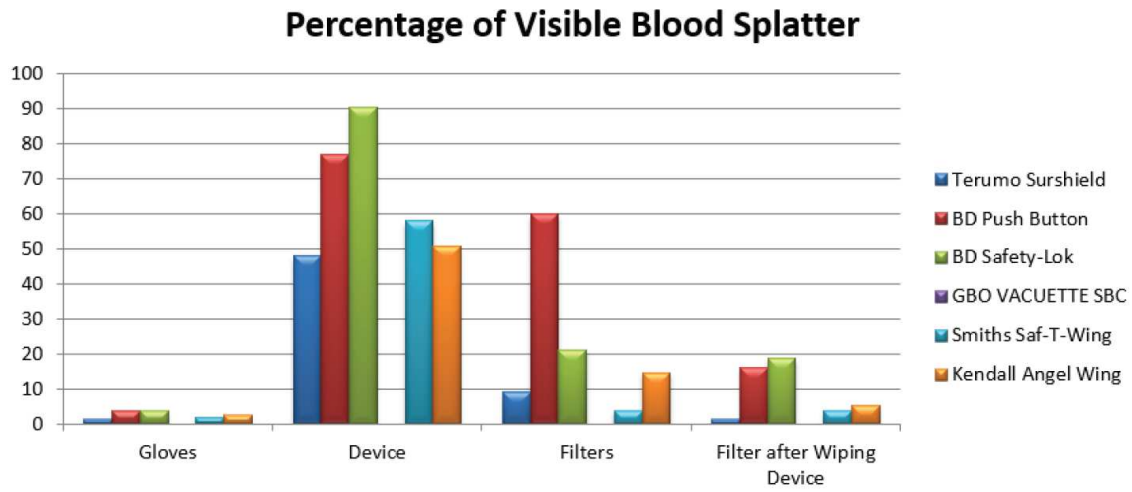

Figure 1 Percentage of visible blood splatter

References

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