

# SmartSite® needle-free valve flush study

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## Overview:

How much fluid does it take to clear a needle-free valve? Does it matter whether the solution to be cleared is aqueous or proteinaceous? Does the speed of injecting the flush solution impact the clearance? These questions are important in clinical infusion practices, particularly in special patient populations like neonates and pediatric patients. To answer these questions, CareFusion commissioned an independent laboratory<sup>1</sup> to conduct a study.

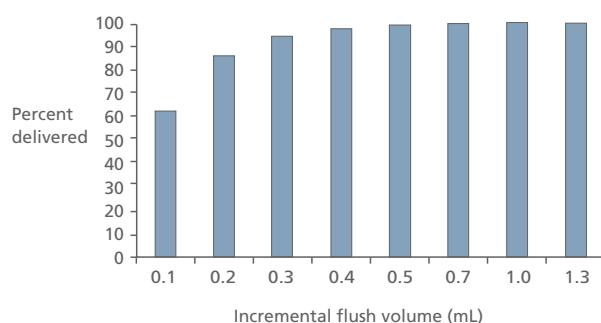
The first phase of the study evaluated how much flush solution is needed to be pushed through the SmartSite® valve in 0.1 mL increments to remove an aqueous (sodium fluorescein) or a proteinaceous (bovine serum) test solution from the valve. In the second phase, the volume of fluid needed to clear 99.9% of each test solution as determined in Phase I was pushed as a single infusion at two different rates (see Phase II below). The results of this study are as follows<sup>2</sup>:

## Phase I: Fluid Clearance Data:

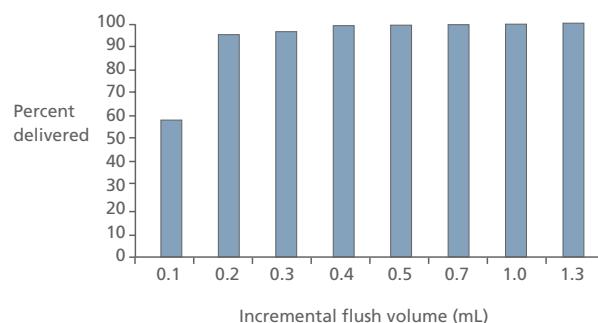
With this aqueous solution, 99.9% of the sodium fluorescein was removed when 0.7 mL of flush solution had been infused though the valve. All (100%) of the sodium fluorescein was recovered when 1.3 mL had been delivered through the valve.

The results of this part of the study were similar to the data for the aqueous solution. However, it took 1 mL to clear 99.9% of the serum and with 1.3 mL infused through the valve, 99.95% of the serum had been cleared.

Cumulative Clearance of Sodium Fluorescein



Cumulative Clearance of Bovine Serum



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## Phase II: Flush Force Data:

Because different volumes of flush solution can be administered at different rates depending on the pressure applied to the syringe plunger, we elected to study the impact of a fast flush (one second) versus a slow flush (five seconds). The flush volumes used for this phase of the study were the volumes determined in Phase I (tenth of a milliliter incremental pushes) to result in 99.9% delivery of the test solutions. Thus for sodium fluorescein 0.7 mL was used and for serum, 1 mL was used.

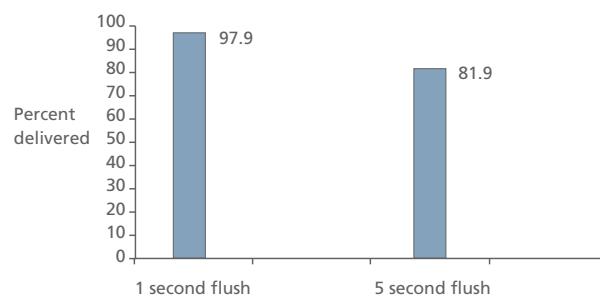
There are several points worthy of note from this phase of the study. First, the flush volumes from Phase I (0.7 and 1 mL) that resulted in 99.9% valve clearance when delivered at tenth of a mL increments did not result in 99.9% clearance when given as a single push at either rate. This is not surprising since incremental division and delivery of a flush volume will result in increased turbulent forces to clear the valve. Second, the valves were more completely cleared with the "fast" versus the "slow" flush.

## Conclusions:

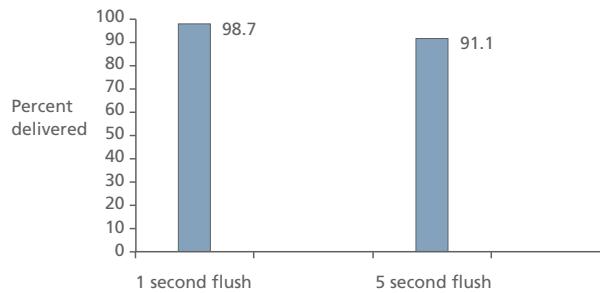
Based on the results of this study, several recommendations can be made for flushing the SmartSite® valve:

- When small flush volumes (0.5 mL) are desired, delivering the flush solution in tenth of a mL increments more completely clears the valve than delivering the entire volume in one push. For both aqueous and proteinaceous solutions, 0.5 mL delivered as five successive 0.1 mL increments yielded over 99% delivery of the test solutions.
- Very slow flushing of the entire flush volume (five seconds for 0.7 and 1 mL in this study) resulted in incomplete delivery of the test solutions (81.9% for aqueous and 91.1% for proteinaceous solutions). Flushes of these volumes at this very slow rate are to be discouraged.
- Fast flushes of the entire flush volume (one second for 0.7 and 1 mL in this study) resulted in more complete delivery of the test solutions (97.9% for aqueous and 98.7% for proteinaceous solutions). This flush rate would be preferred

## Effect of Flush Force – Sodium Fluorescein (0.7 mL flush)



## Effect of Flush Force – Bovine Serum (1 mL flush)



over the five-second push for small volume flushes (1 mL or less). The force applied with the flush syringe should also take into account the recommendations of the catheter manufacturer if restricted patient venous access is involved since forceful syringe pushes can generate high pressures in this setting.

- The data suggests that appropriate flush procedures employing low volumes can be used successfully to clear the SmartSite® valve. This knowledge is probably most important for neonatal/pediatric practice but is also applicable whenever efficient flushing with low fluid volumes is important. Obviously, determining the right flush volume must also take into account other factors such as the patient's venous access device (catheter).

1 Science Consultants to Industry Rae Drazin, PhD, Los Angeles, California.

2 Data on file at Cardinal Health.

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