5PSQ-013

NEW METHOD FOR ASSESSMENT OF ENVIRONMENTAL VIRAL CONTAMINATION OF LIQUIDS PREPARED IN CLOSED-SYSTEM DRUG TRANSFER DEVICES

Maya Amichay[a], Elana A. Slutsky Smith[b*]
[a] Hy Laboratories Ltd., Rehovot, Israel | [b] Simplivia Healthcare Ltd., Kiryat Shmona, Israel

Background and Importance:

Closed system transfer devices (CSTDs) protect healthcare professionals during preparation and administration of hazardous drugs, while maintaining drug sterility.

CSTDs are sometimes used for dose preparation outside a controlled environment. Drugs contaminated by microbes harbor clinical risk to patients. Drugs suspected of contamination must be disposed, adding economic burden to pharmacies.

A method for testing CSTDs' ability to prevent viral contamination is needed.

Aims and Objectives:

The aim was to develop a method for evaluating CSTDs' ability to prevent viral contamination.

Materials and Methods:

Case studies were performed with Chemfort®[1] and PhaSeal™[2] Optima CSTDs inside a glove box continuously aerosolized with human coronavirus HCoV-OC43.

With Chemfort®, reconstitution was simulated by transferring 10 ml sterile saline from an IV bag to a vial and back to the IV bag (Figure 1).

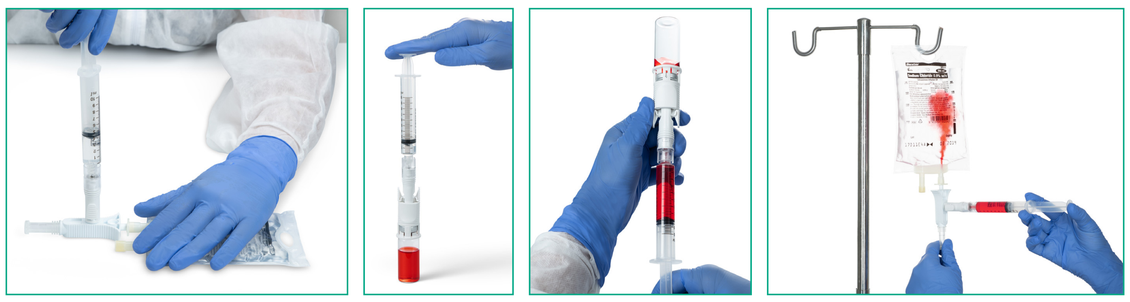

Figure 1. *Simulated preparation steps performed using Chemfort® in a virus-contaminated environment*

With Optima™, bolus preparation was simulated by transferring 20 ml sterile saline from a vial to a syringe, and infusion preparation was simulated by transferring 20 ml sterile saline from a vial, via syringe, into an IV bag (Figure 2). To withdraw liquid from a vial using Optima™, environmental air must first be used to prime the syringe and inflate the vial adaptor balloon.

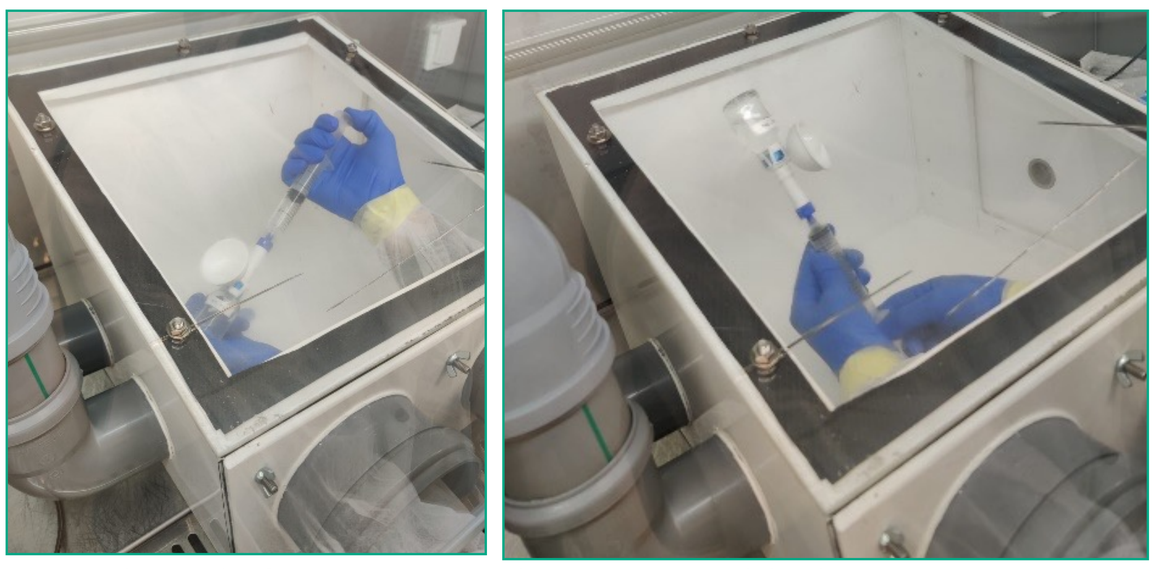

Figure 2. *Photographs of Optima™ operation in the virus-contaminated glove box*

For all simulations, 3 repetitions times 3 technical replicates were performed. HCoV-OC43 RNA in syringes and IV bags was quantified by qPCR.

Air sampling verified the continued presence of viral aerosols in the glove box. For negative control, liquid transfers were performed in the presence of sterile medium aerosols.

Presenting Author: Elana Slutsky Smith, Ph.D.
e-mail: elana.slutskysmith@simplivia.com

Results:

The concentration of viral RNA was calculated from a standard curve (Figure 3).

Viral RNA could be quantified at concentrations ≥ 5 plaque forming units (PFU)/ml (cycle threshold [Ct] value ≤ 36.58).

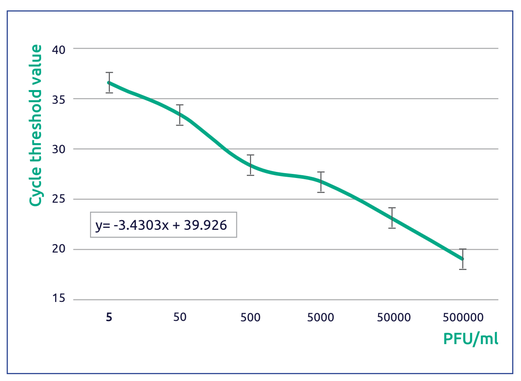

Figure 3. *Standard curve results obtained in Chemfort® study. Curve obtained in Optima™ study was comparable. PFU = plaque forming units.*

Chemfort®: No viral RNA traces were detected in any of the 9 replicates (Table 1).

Table 1. *PCR viral RNA quantification results for Chemfort® experiment. ND = not detected; air sample I-before liquid transfers, air sample II-after liquid transfers. Green indicates no viral traces detected.*

Group	Biological repeat	Ct value Replicate number 1	2	3	PFU/ml (average)
Negative Control	1	ND	ND	ND	0
Chemfort® reconstitution simulation	1	ND	ND	ND	0
	2	ND	ND	ND	0
	3	ND	ND	ND	0
Air sample I	1	21.47	21.35	21.41	123,333
Air sample II	1	23.29	23.25	23.28	35,667

Optima™: In bolus simulations, viral RNA traces were observed in all 9 replicates, 56% of which were within the quantifiable range (Ct <= 36.58). In infusion simulations, traces were observed in 67% of replicates, but these were below the quantifiable range (Table 2).

Table 2. *PCR viral RNA quantification results for Optima™ experiment. ND = not detected; air sample I-before liquid transfers, air sample II-after liquid transfers. Red indicates quantifiable viral RNA. Yellow indicates viral traces below the quantifiable range. Green indicates no viral traces detected.*

Group	Biological repeat	Ct value Replicate number 1	2	3	PFU/ml (average)
Negative Control	1	ND	ND	ND	0
Optima™ bolus simulation	1	36.86	36.25	37.67	3.8
	2	36.09	34.72	35.73	9.4
	3	37.60	36.72	36.48	3.8
Optima™ infusion simulation	1	36.06	36.71	37.79	4
	2	ND	37.54	ND	2.5
	3	38.06	36.05	ND	3.5
Air sample I	1	22.14	22.27	22.17	52,653
Air sample II	1	21.46	21.52	21.43	84,119

Conclusion and Relevance:

A method was developed for testing CSTDs' ability to prevent viral contamination. The method was applied to two CSTDs for different simulated pharmacy tasks. Chemfort® prevented viral ingress, possibly assisted by antiviral properties of the carbon matrix integral to its Toxi-Guard® barrier,[3] while Optima™ demonstrated a considerable risk for contamination of the liquids. This is likely due to the entry of contaminated air during syringe priming and vial adaptor balloon inflation. This step is not required by all CSTDs.

The method can be applied for evaluation of additional CSTDs and for direct comparison between CSTD brands performing the same tasks. The knowledge gained could help protect vulnerable patients from viral infection.

References:

[1] Amichay M, Shimon O, Raveh E. (2021) Pharm Pract; 19(4): 2576.
[2] Simplivia data on file: HyLabs report F11-455-01
[3] Chemviron. (2024). Flexorb® activated carbon cloth. Retrieved February 12, 2024, from https://www.chemviron.eu/solutions/activated-carbon/activated-carbon-cloth/

Acknowledgements:

Funding was provided by Simplivia Healthcare Ltd, the manufacturer of Chemfort®.