

# Extended Use Microbial Challenge and Disinfection Study of the CLAVE® Connector

## Introduction

ICU Medical, Inc. of San Clemente, California has been manufacturing and marketing the CLAVE Connector since 1993. New standards in IV therapy are being directed towards longer use life for connecting devices such as the CLAVE Connector. In order to reduce costs yet maintain quality medical care, products proven to be effective in the hospital as well as alternate site for longer than the recommended usage, will better suit the needs of some health care agencies. In the interest of safety and efficacy, ICU Medical has microbially challenged the CLAVE Connector in this study for a period of six days using multiple activations in order to validate its ability to maintain a physical microbiological barrier. The CLAVE Connector is a swabable system, as well as a physical barrier to bacteria under normal clinical settings.

In this study the CLAVE Connector is microbially challenged to a rigorous use model in order to demonstrate its integrity when subjected to what would be considered a worst case clinical scenario. Samples of the CLAVE were artificially contaminated with *Pseudomonas aeruginosa* in order to determine if it can thereafter be effectively decontaminated with a standard disinfection protocol. *Pseudomonas aeruginosa* in a  $8.9 \times 10^3$  population was selected as the challenge organism for its aggressive characteristics in a clinical environment. The CLAVE is designed to maintain a physical barrier with repeated exposure to microorganisms. The samples were accessed using twenty four (24) bolus pushes of sterile saline every twenty four (24) hours for a period of six (6) days to demonstrate the worst case clinical model. The multiple activations and the duration of the study were chosen to show the integrity of the product as a "stressed" system.

## Protocol

To validate the ability of the CLAVE Connector to prevent microbial contamination, Laboratory Services, Inc. of Monrovia, California was contracted to perform the independent study. Twenty samples of the CLAVE were selected as required by the United States Pharmacopoeia (USP) for sterility testing. The test also included a positive control, negative control, and four population verification samples. The twenty test samples and the controls were challenged against the simulated use model. The test units were assembled onto individual sterile filter funnel units. Each of the twenty samples and the positive control were inoculated with an average of more than 870 colony forming units (CFUs) as confirmed by the population verification samples. To simulate the worst case clinical model, the samples were then disinfected with a 70% sterile alcohol swab and accessed with a 10mL bolus push of sterile saline. The saline wash was passed through the filter into

funnel unit, and the filter membrane was then incubated in SCDB for seven days or 168 hours at 32-35°C. Any microbial contaminants were identified and characterized. The positive control was flushed with 10mL of a nominal  $1.0 \times 10^2$  /mL volume of challenge suspension. The negative control was processed by eliminating the inoculation procedure.

## Results

The study indicated no microbial contamination of the CLAVE Connector for six days or 144 hours. Initial contamination of the CLAVE was verified to be at least 870 CFUs per sample on average. The ability of the CLAVE Connector to maintain its integrity as a "stressed" system when microbially challenged under a worst case clinical simulation is demonstrated in the following table.

Time	Number samples positive for <i>P. aeruginosa</i>	Positive Control	Negative Control
24h	0/20	1/1	0/1
48h	0/20	1/1	0/1
72h	0/20	1/1	0/1
96h	0/20	1/1	0/1
120h	0/20	1/1	0/1
144h	0/20	1/1	0/1

## Conclusion

In all cases the CLAVE Connector was able to maintain a physical barrier for 144 hours (six days) while administering 24 repeat activations per day for a total of 144 activations. The study results indicate that the CLAVE Connector when using a standard disinfection protocol did not increase infection rates under a worst case clinical simulation.

## Recommendations

- Use aseptic technique and accepted IV practice.
- Swab CLAVE Connector using desired disinfectant in accordance with facility protocol.
- Flush CLAVE Connector after each use in accordance with facility protocol.
- Change the CLAVE Connector according to CDC Guidelines or validated facility protocol.

# The CLAVE<sup>®</sup> Connector

## Performance with High Risk Infusates

### Introduction

It has come to the attention of **ICU Medical, Inc.** that some infusates, used in high risk clinical applications, can cause a plastic device such as the CLAVE Connector to degrade and not function as intended. The CLAVE Connector is designed to be a universal connector, capable of withstanding such infusates in order to qualify it for most clinical applications. This study is used to demonstrate the functional integrity of the CLAVE Connector when used with certain infusates that are known to be incompatible with plastics. The CLAVE Connector is manufactured using polycarbonate, polyester and silicone components. Five different drugs were used to conduct this study as follows: Taxol, Cisplatin, Adriamycin, Oncovin and Lasix.

### Procedure

Sixty samples of the CLAVE Connector were assembled together as one test setup. The test infusate was prepared per the manufacturer's instructions and available in a 5cc luer lock syringe. Water available in a 5cc syringe was used as the study control. The syringe containing the test infusate was attached to the proximal end, or the silicone seal of the test setup, by fully activating the CLAVE Connector and securing the luer lock connection. The contents of the syringe was infused through the entire string of connectors until an excess of the drug was captured in a secondary syringe. The capture syringe was attached using a double female connector at the distal end or male luer of the CLAVE Connector test setup. The entire setup was a closed system and was monitored for leakage at any of the connection points. At one hour intervals the samples were tested for patency by pushing at the proximal syringe, and then reversing the action by pushing at the distal syringe. This action was repeated twenty four (24) times per day, for seventy two (72) hours or three days. At all times each of the CLAVE Connectors was exposed to the test infusate and the patency test. Following the three days of exposure the test infusate was disposed of per the manufacturer's instructions and the samples were generously flushed to remove any drug residue.

The samples then underwent functional and visual evaluation according to the CLAVE Connector's performance specifications. Flow testing was used to identify any degradation of the internal polycarbonate spike component. Backpressure testing to 60 psig was used to identify any degradation of the silicone seal and polyester housing. All samples were visually inspected for degradation. The results of the study are reported in the following table:

### Results

Test Infusate	Flow Rate: number of failures per 60 samples	Backpressure: number of failures per 60 samples	Overall Failure Rate for Test Infusate
Taxol (2mg/mL):	0/60	0/60	0%
Cisplatin (2mg/mL):	0/60	0/60	0%
Adriamycin (3mg/mL):	0/60	0/60	0%
Oncovin (1mg/mL):	0/60	0/60	0%
Lasix (100mg/mL):	0/60	0/60	0%
Control Water:	0/60	0/60	0%

### Conclusions

The CLAVE Connector met its functional specifications following exposure to the test infusate. According to this study the CLAVE Connector should not suffer from any degradation when used with Taxol, Cisplatin, Adriamycin, Oncovin and Lasix.

**CAUTIONS:** Federal (USA) law restricts this device to sale by or on the order of a physician.  
It is recommended this device be changed per CDC guidelines or per validated facility protocol

US. PAT. NOS; 5,685,866; 5,690,612; 5,694,686; 5,695,466; 5,873,862; 5,901,942; 5,928,204; 6,132,403;  
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6,682,509; 6,726,672 Other Patents Pending