A Pathogen-Agnostic UV Irradiation Platform for Rapid Inactivation of Diverse Biological Threats

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Emerging biological threats demand pathogen-agnostic countermeasure platforms capable of rapid response across diverse pathogen classes. Conventional approaches often not broad spectrum and slow acting , limiting operational flexibility. The ABGI Ultraviolet Blood Irradiator (UBI) is a compact, modular platform leveraging ultraviolet-based pathogen reduction technology (PRT) to inactivate bacteria, viruses, and parasites in human plasma or blood without additives. Its microfluidic cassette architecture enables standardized treatment across biologically distinct threat agents, supporting biodefense and emergency medical readiness. The ABGI UBI V.4 was evaluated against 10 biologically diverse pathogens spiked in human plasma at approximately 10^6 CFU/ml or TCID50/ml. Pathogens were selected for structural and taxonomic diversity: gram-negative bacteria (*P. aeruginosa*, *E. coli*, *S. marcescens*), a gram-positive spore former (*B. cereus*), enveloped DNA viruses (Pseudorabies virus) and non-enveloped (Adenovirus), and enveloped RNA viruses (La Crosse virus, Vesicular Stomatitis virus, Sindbis virus) and non-enveloped (Bluetongue virus). All samples were treated at 13% intensity using a disposable microfluidic cassette. Bacterial reduction was quantified by colony enumeration. Viral reduction was assessed by TCID50 cytopathic effect assay. All testing was performed in triplicates. The platform demonstrated broad-spectrum efficacy across all pathogen classes. Three gram-negative bacteria achieved 100% elimination: *P. aeruginosa* (6.57-log), *E. coli* (6.12-log), and *S. marcescens* (6.09-log). *B. cereus* spores were reduced by 95% (1.34-log). All six viruses showed greater than 99% reduction: Bluetongue virus (99.96%), Pseudorabies virs (99.72%), VSV (99.65%), Adenovirus (99.60%), La Crosse (99.19%), and Sindbis (99.17%). Efficacy was consistent across enveloped and non-enveloped, DNA and RNA viral models, demonstrating versatility independent of the type of pathogen. The ABGI UBI provides a pathogen-agnostic, non-pharmaceutical countermeasure with demonstrated efficacy across structurally diverse biological threats. The microfluidic cassette design and absence of chemical additives support rapid deployment, simplified logistics, and scalable manufacturing for military biodefense, pandemic preparedness, and expeditionary medical operations where threat identification may be delayed or unavailable.

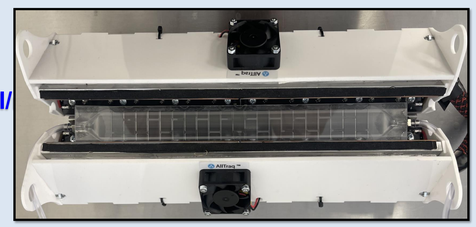
Clinical and Military Relevance

- ❑ **To evaluate the pathogen reduction efficacy of the ABGI Ultraviolet Blood Irradiator (UBI) platform in inactivating bacterial, viral, and parasitic contaminants in human plasma or blood.**
- ❑ **This advanced, patent-pending technology enables pathogen reduction for diverse biological threat agents, enhancing emergency medical readiness for our service members.**

The ABGI Blood Irradiator leverages Ultraviolet Blood Irradiation (UBI) Pathogen Reduction Technology (PRT) to provide a state-of-the-art, pathogen-agnostic platform for force health protection, enabling standardized treatment across biologically diverse threat agents.

Pathogen Spiked Human Plasma

Test Parameters:
- **Flow Rate: 2.25 ml/**
- **Intensity: 13%**



ABGI Irradiator with Microfluidic Cassette

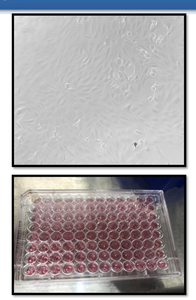
Antibacterial Efficacy Evaluation of ABGI UV Blood Irradiator

- ❑ **Antibacterial efficacy testing of ABGI UV Blood Irradiator was conducted using biologically diverse bacterial pathogens including gram negative bacteria (*P. aeruginosa, E. coli, and S. marcescens) and a gram-positive spore former (B. cereus)* spiked into Human Plasma.**
- ❑ **Each bacteria was spiked in Human Plasma at ≃ 10^6 CFU/ml n and ABGI UV treated plasma samples were tested at 13% intensity in triplicates.**

Bacterial Culture

Antiviral Efficacy Testing of ABGI UV Blood Irradiator

- ❑ **Antiviral efficacy testing of the ABGI UV Blood Irradiator was conducted using biologically diverse viruses spiked into human plasma, including Pseudorabies Virus (PRV) (an enveloped DNA virus), Adenovirus (a non-enveloped DNA virus), enveloped RNA viruses such as La Crosse Virus, Vesicular Stomatitis Virus (VSV), and Sindbis Virus (SINV), and the non-enveloped Bluetongue Virus.**
- ❑ **Each virus was spiked into Human plasma at ≃ 10^6 TCID50/ml and ABGI UV treated plasma samples were tested at 13% intensity in triplicates.**
- ❑ **Samples were than serially diluted with appropriate EMEM tissue culture media and plated onto 96-well plate for TCDI50/ml Cytopathic Effect Assay (CPE).**

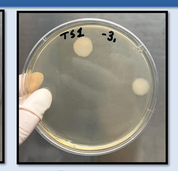


TCID50 Cytopathic Effect Assay

Antibacterial Efficacy of ABGI UV Treated Spiked Human Plasma Results

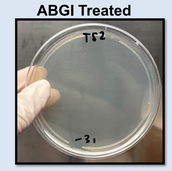
Organism	Control Spike Plasma CFU/ml	Control Spike Plasma Log 10	Treated Spike Plasma CFU/ml	Treated Spike Plasma Log 10	Average Log Reduction	Average Percent Reduction
P. aeruginosa	3.80 x 10^6	6.57	00	00	6.57	100%
E. coli	1.40 x 10^6	6.12	00	00	6.12	100%
B. cereus	5.20 x 10^5	5.71	2.50 x 10^4	4.37	1.34	94.99%
S. marcescens	1.22 x 10^6	6.09	00	00	6.09	100%

B. cereus Control



B. cereus ABGI Treated

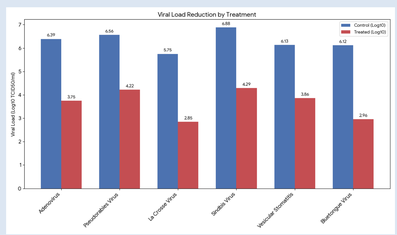
S. marcescens Control

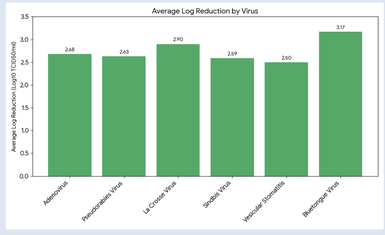


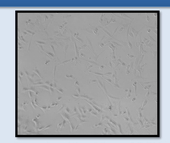
S. marcescens Treatment

Antiviral Efficacy of ABGI UV Treated Spiked Human Plasma Results

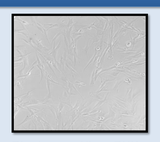
Virus	Control Spike Plasma TCID50/ml	Control Spike Plasma Log 10	Treated Spike Plasma TCID50/ml	Treated Spike Plasma Log 10	Average Log Reduction	Average Percent Reduction
Adenovirus	2.46 x 10^6	6.39	1.24 x 10^4	3.75	2.68	99.60%
Pseudorabies Virus	7.05 x 10^6	6.56	1.94 x 10^4	4.22	2.63	99.72%
La Crosse Virus	5.65 x 10^5	5.75	4.52 x 10^3	2.85	2.90	99.19%
Sindbis Virus	7.63 x 10^6	6.88	6.34 x 10^4	4.29	2.59	99.17%
Vesicular Stomatitis	2.29 x 10^6	6.13	7.97 x 10^3	3.86	2.50	99.65%
Bluetongue Virus	1.33 x 10^6	6.12	1.93 x10^3	2.96	3.17	99.96%



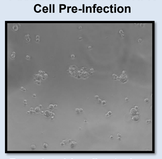




Pseudorabies Virus CRFK Cell Pre-Infection

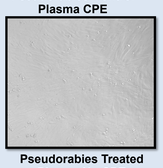


Bluetongue Virus BHK-21 Cell Pre-Infection

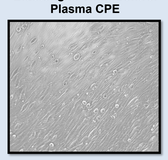


Pseudorabies Control Plasma CPE

Bluetongue Virus Control Plasma CPE



Pseudorabies Treated Plasma No CPE



Bluetongue Virus Treated Plasma No CPE

Results

- ❑ **Significant Killing Efficacy was observed at the 13% power intensity for bacteria and viruses tested.**
- ❑ **Killing rate 100% starting at 13% intensity was observed *for P. aeruginosa, E. coli, and S. marcescens*.**
- ❑ **Killing rate was more than 94% for *B. cereus (spore former)* starting at 13% intensity.**
- ❑ **Killing rate was more than 99% starting at 13% intensity for all the six viruses tested.**

Conclusion

- ❑ **The ABGI Blood Irradiator demonstrated broad-spectrum killing efficacy across all pathogen classes tested. This pathogen reduction technology provides a rapidly deployable, pathogen-agnostic, non-pharmaceutical solution for treating infected blood and blood products for both military and civilian populations.**

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