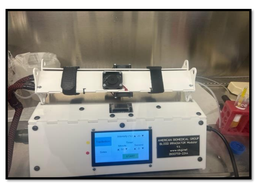
Ruggedized Broad-Spectrum Pathogen Reduction Technology for Human Plasma or Blood Decontamination in Austere Environments

James K. Burgess, III [1], Mina Izadjoo[2], Scott Cohen[1], Phil Chivers[1], Mark Chivers[1], and Josh Anderson[1],
American Biomedical Group, Inc. (ABGI), Oklahoma City, OK, [2]Integrated Pharma Services, Rockville, MD

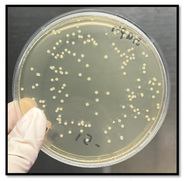
Transfusion-transmitted infections pose a critical threat to force health protection in combat and prolonged field care where pre-donation screening may be unavailable. The ABGI Ultraviolet Blood Irradiator (UBI) is a compact, non-additive pathogen reduction technology (PRT) designed to mitigate bloodborne infection risk in human plasma, preserving blood component integrity while providing broad-spectrum pathogen inactivation across bacteria, viruses, and parasites. Human plasma was spiked with 10 militarily relevant bloodborne pathogens spanning three classes: bacteria (*S. aureus*, *S. epidermidis*, *Y. enterocolitica*, *K. pneumoniae*), viruses (HIV-1, West Nile Virus, Human Coronavirus OC43, Influenza A H1N1, H1N1 (H5N1 surrogate), and one parasite (*L. donovani*). Each pathogen was spiked at approximately 10^6 CFU/ml (bacterial pathogens) or TCID50/ml (Viral pathogens). Samples were treated using the ABGI UBI V.4 at 13% intensity. Bacterial reduction was quantified by colony enumeration. Viral reduction was assessed by TCID50 cytopathic effect assay. Parasite viability was determined by hemocytometer counts. All testing was performed in triplicates. The ABGI UBI demonstrated significant pathogen reduction across all three classes. *K. pneumoniae* and *Y. enterocolitica* achieved 100% elimination (log reductions of 6.41 and 7.00 respectively). *S. aureus* and *S. epidermidis* were reduced by greater than 99.5%. All five viruses showed greater than 99% reduction including HIV-1 (99.20%, 2.18-log), West Nile Virus (99.68%), Coronavirus OC43 (99.71%), Influenza A (99.79%), and H5N1 surrogate (99.87%). *L. donovani* was reduced by approximately 89% with optimization ongoing. The non-additive approach preserved functional integrity of treated plasma, eliminating chemical logistics requirements. The ABGI UBI provides a field-ready, cost-effective, non-pharmaceutical countermeasure for mitigating bloodborne infections in military transfusion settings. Its efficacy across bacteria, viruses, and parasites supports its role in reducing transfusion-transmitted infection risk under combat and prolonged field care conditions. The compact design and absence of chemical additives make it suited for austere environments where screening infrastructure and cold chain logistics are limited. Further optimization and regulatory assessment will advance integration into military blood safety protocols and force health protection strategies.

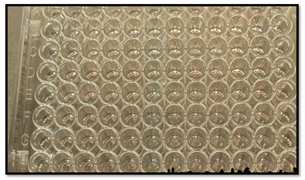
Clinical and Military Relevance

- ❑ **To evaluate the antimicrobial and antiviral efficacy of a portable, ruggedized Ultraviolet Blood Irradiator (UBI), ABGI Pathogen Reduction Technology (PRT) for broad-spectrum inactivation of bacterial, viral, and parasitic blood related pathogens.**
- ❑ **This advanced, patent-pending technology uses a non-pharmaceutical/non-additive approach to support safer transfusions in combat, prolonged field care and emergency settings.**


ABGI Blood Irradiator


Human Plasma


Bacterial Culture


TCID50 Cytopathic Effect Assay

- **The ABGI Blood Irradiator, leveraging the Pathogen Reduction Technology (PRT) of Ultraviolet Blood Irradiation (UBI) emerges as state-of-the-art technology for force health protection.**

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

Antimicrobial Efficacy Evaluation of ABGI UV Blood Irradiator

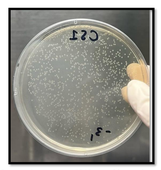
- ❑ **Antimicrobial efficacy testing of ABGI UV Blood Irradiator was conducted using various bacterial pathogens including *S. aureus, S. epidermidis, Y enterocolitica, and K. pneumoniae* spiked into Human Plasma.**
- ❑ **Each bacteria was spiked in Human Plasma at ≃ 10^6 CFU/ml and ABGI UV treated plasma samples were tested at 13% intensity in triplicates. Bacterial numbers were determined by serial dilution and plating.**
- ❑ **One parasite, *Leishmania donovani* was also tested to evaluate the efficacy of the ABGI UV Blood Irradiator.**
- ❑ **The stock parasite was cultured in the appropriate growth medium and then spiked into human plasma at ≃ 10^6 cells/mL and plasma samples were treated at 13% intensity in triplicates. Control and treated samples were quantified using a hemocytometer under a microscope.**

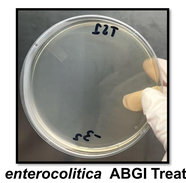
Antiviral Efficacy Testing of ABGI UV Blood Irradiator

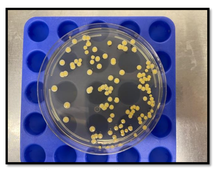
- ❑ **Antiviral efficacy testing of ABGI UV Blood Irradiator was conducted using the following viruses spiked into Human Plasma: HIV-1, West Nile Virus (WNV), Human Coronavirus OC43, Influenza A H1N1, and H1N1 (H5N1 Surrogate).**
- ❑ **Each virus was spiked into Human plasma at ≃ 10^6 TCID50/ml and ABGI UV treated plasma samples were tested at 13% intensity in triplicates.**
- ❑ **Samples were than serially diluted using appropriate tissue culture media (EMEM, RPMI) and plated onto 96-well plates for TCDI50/ml Cytopathic Effect Assay (CPE).**

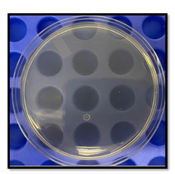
Antimicrobial Efficacy of ABGI UV Treated Spiked Human Plasma Results

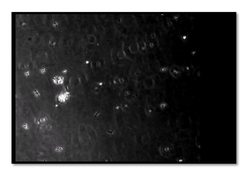
Organism	Control Spike Plasma CFU/ml	Control Spike Plasma Log 10	Treated Spike Plasma CFU/ml	Treated Spike Plasma Log 10	Average Log Reduction	Average Percent Reduction
S. aureus	1.76 x 10^6	6.24	2.29 x 10^3	3.29	2.96	99.87%
S. epidermidis	1.51 x 10^6	6.18	6.67 x 10^3	1.43	5.55	99.54%
Y. enterocolitica	3.10 x 10^7	7.00	00	00	7.00	100%
K. pneumoniae	2.67 x 10^6	6.41	00	00	6.41	100%
L. donovani	4.31 x 10^6 cells/ml	6.62	4.65 x 10^5	5.66	0.96	~89.21%


Y. enterocolitica Control


Y. enterocolitica ABGI Treated


S. aureus Control

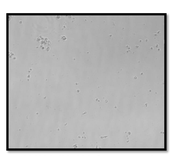

S. aureus ABGI Treated

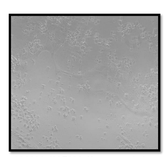

Leishmania donovani

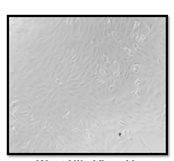
Antiviral Efficacy of ABGI UV Treated Spiked Human Plasma Results

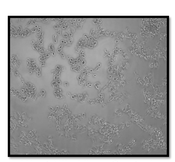
Virus	Control Spike Plasma TCID50/ml	Control Spike Plasma Log 10	Treated Spike Plasma TCID50/ml	Treated Spike Plasma Log 10	Average Log Reduction	Average Percent Reduction
HIV-1 IIIB	6.81 x 10^5	5.18	5.43 x 10^3	3.66	2.18	99.20%
West Nile Virus	7.76 x 10^6	6.89	2.49 x 10^4	4.05	2.84	99.68%
Coronavirus OC43	1.44 x 10^6	6.16	4.18 x 10^3	3.59	2.57	99.71%
Influenza A H1N1	1.35 x 10^6	6.13	2.82 x 10^3	3.41	2.72	99.79%
H1N1 (H5N1 Surrogate)	2.43 x 10^6	6.39	3.15 x 10^3	3.75	2.99	99.87%

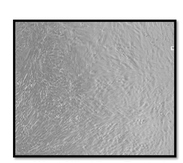

H1N1 (H5N1 Surrogate) Virus MDCK Cell Pre-Infection


H1N1 (H5N1 Surrogate) Control Plasma CPE


H1N1 (H5N1 Surrogate) Treated Plasma No CPE


West Nile Virus Vero Cell Pre-Infection


West Nile Virus Control Plasma CPE


West Nile Virus Treated Plasma No CPE

Results

- ❑ **Significant Killing Efficacy was observed for all the bacteria and viruses tested.**
- ❑ **Killing rate 100% starting at 13% intensity was observed *for Y. enterocolitica and K. pneumoniae.***
- ❑ **Killing rate was more than 99% starting at 13% intensity for *S. aureus and S. epidermidis.***
- ❑ **Killing rate was ~89% *L. donovani* parasite starting at 13% intensity. Additional testing is ongoing.**
- ❑ **Killing rate was more than 99% starting at 13% intensity for all five viruses tested.**

Conclusion

- ❑ **The ABGI Blood Irradiator demonstrated a significant reduction in bacterial and viral activity. This portable, ruggedized, non-additive technology is well suited for austere and battlefield environments with limited blood screening infrastructure, supporting future military blood safety applications.**

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