Inactivation of *Clostridium difficile* by 405nm HINS-light

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Clostridium difficile

- *Clostridium difficile* is a major cause of **hospital-associated diarrhoea** that can be fatal for the young, elderly and immunocompromised.
- Under adverse conditions, this anaerobic bacterium forms **spores** which can survive in the environment up to 5 months
- It is transmitted mainly by the oral-faecal route, however the environment also plays an important role in transmission.

HINS-light

- HINS-light is a novel light-based decontamination method which uses visible violet light, with a peak wavelength of **405nm**, to induce lethal oxidative damage to exposed microorganisms.
- HINS-light has been used to develop an environmental disinfection system for use in hospital isolation rooms

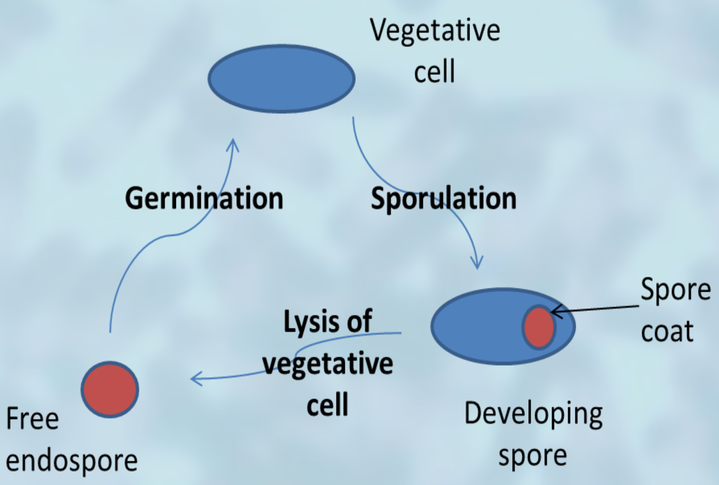
Spores vs Vegetative cells

C. difficile spores are 10-15 times more resistant to various chemicals and physical agents than vegetative cells.

This makes spores difficult to eradicate and facilitates spread of *C. difficile* in the environment.

C. difficile sporulation is triggered under adverse conditions i.e.. in aerobic conditions, dessication, and starvation, such as the hospital environment

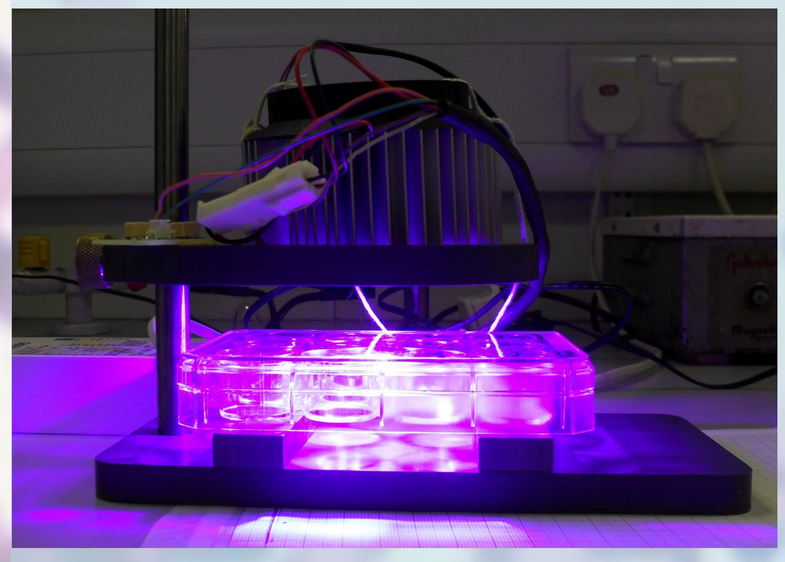
C. difficile sporulation cycle



Aims

To establish the susceptibility of *C. difficile* vegetative cells and spores to 405nm light

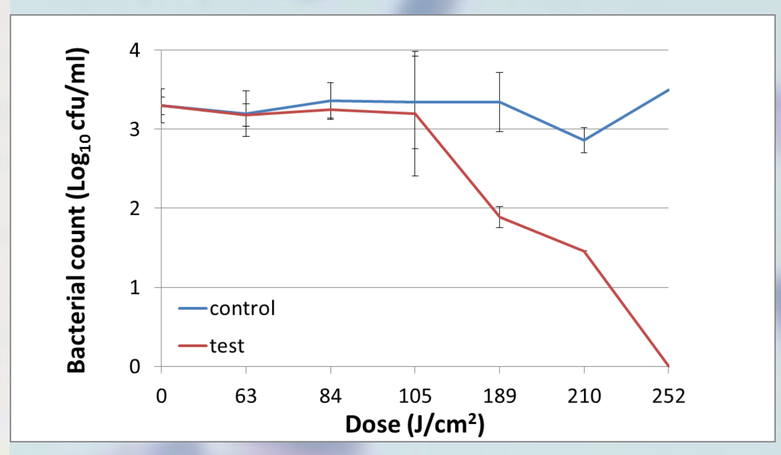
This could aid development of this novel method for the reduction of *C. difficile* contamination, and cross-infection within the hospital environment.



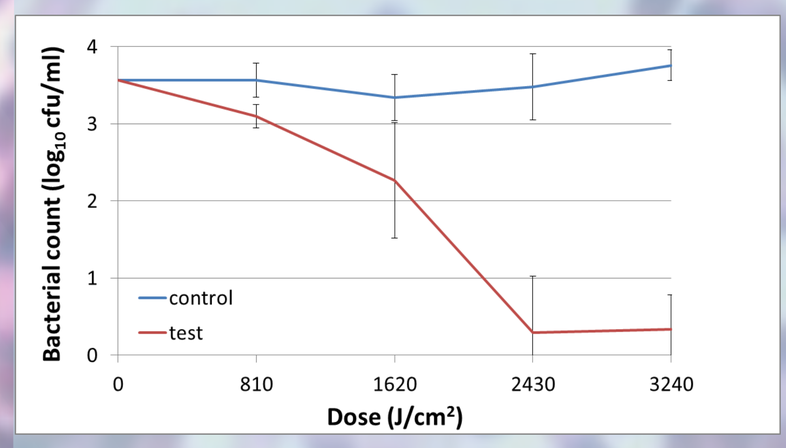
Methods

Spore and vegetative cell suspensions were exposed to high irradiance 405nm light, and surviving populations enumerated.

Results



Exposure of vegetative cells to 252 J/cm² 405nm HINS-light achieves a 3-log$_{10}$ population reduction.



Spores require a dose of 2430 J/cm² to achieve a similar 3-log$_{10}$ reduction, demonstrating the higher resilience of spores compared to vegetative cells.

Conclusions and Further Research Questions

- In conclusion, it is evident that 405nm HINS-light can successfully be used for the **inactivation** of both *Clostridium difficile* vegetative cells and spores.
- Spores however are much more resilient than vegetative cells, requiring more than 10x the dose for inactivation compared to vegetative cells to achieve a ~3.5 reduction.

- Can inducing germination of spores enhance HINS-light decontamination?
- Can synergistic decontamination be achieved through combined use of 405nm light and disinfectants?
- Can this decontamination effect be replicated in the clinical environment?

EPSRC Engineering and Physical Sciences Research Council

ROLEST The Robertson Trust Laboratory for Electronic Sterilisation Technologies