

# First UK trial of Tru-D: An automated UV-C room decontamination device

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## BACKGROUND

The Tru-D™ rapid room disinfection device is a mobile, automated room decontamination technology utilizing ultraviolet-C (UV-C) irradiation to kill micro-organisms.

This device has been previously reported to significantly reduce nosocomial pathogens in the healthcare environment such as MRSA, VRE and *Clostridium difficile*,<sup>1,2</sup> making it an interesting potential alternative to systems such as vaporised hydrogen peroxide or dry-mist hydrogen peroxide for terminal disinfection of patient rooms.

However, until recently this technology has not been available in the UK.

## PURPOSE

To perform a rapid trial of the first UK Tru-D unit in an NHS healthcare setting, looking principally at:

- ease of use
- time taken for room disinfection
- microbiological efficacy
  - total surface aerobic counts
  - specific pathogens (MRSA, VRE, MRA and *Aspergillus*)

## MATERIALS AND METHODS

### Deploying Tru-D

The unit was trialed in six side rooms within an Intensive Therapy Unit (ITU), an operating theatre and an ensuite ward sideroom. Measurements were taken to calculate room volume and time taken for disinfection was recorded at two settings (reflected UV-C dose of 12,000  $\mu\text{Ws}/\text{cm}^2$  for vegetative bacteria & a sporicidal setting of 22,000  $\mu\text{Ws}/\text{cm}^2$ ).

### Evaluating microbial efficacy

Assessment was performed using two methods:

#### Contact plates

Tryptone soya agar (TSA) contact plates were applied to surfaces both within the line of sight (LOS) of the Tru-D unit and areas not directly in the line of sight (shadow). TSA contact plates were re-applied to surfaces directly adjacent to original sampling area at the end of the Tru-D disinfection cycle. The total number of colonies before and after disinfection were counted.

#### Plastic Petri dishes seeded with multi-resistant clinical isolates

Suspensions containing MRSA, VRE, MRA or *Aspergillus* were produced (McFarland 0.5-1 [ $1.5-3.0 \times 10^8$  cfu/ml]). A sterile cotton-wool swab was used to spread the inoculum evenly on Petri dishes to produce a confluent/semi-confluent growth of organisms on control plates ( $\sim 10^4/10^5$  colonies/plate). Seeded Petri dishes were then placed on surfaces (line of sight and shadow) and exposed to Tru-D. Control Petri dishes were kept outside. The total number of colonies recovered from TSA contact plates after disinfection were counted and the  $\log_{10}$  reduction compared to controls calculated (see Fig 2).

All TSA contact plates were incubated at 37°C for 48 hours aerobically.

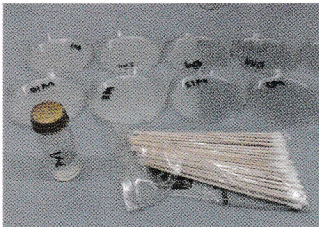


Fig 1: Photograph showing inoculated Petri dishes from a suspension containing VRE

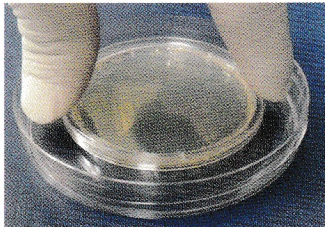


Fig 2: Photograph showing application of a TSA contact plate onto a Petri dish inoculated with MRA

## BIBLIOGRAPHY

1. Rutala WA, Gergen MF, Weber DJ. Room decontamination with UV radiation. *Infect Control Hosp Epidemiol* 2010; 31: 1025-1029.
2. Nerandzic MM, Cadnum JL, Pultz MJ, Donskey CJ. Evaluation of an automated ultraviolet radiation device for decontamination of *Clostridium difficile* and other healthcare-associated pathogens in hospital rooms. *BMC Infect Dis* 2010; 10: 197

## RESULTS

### Using the Tru-D Unit

The Tru-D unit was relatively easy to transport and operate. It was placed in the centre of the rooms and furniture moved away from the walls. The device was operated using a remote control with suitable warning signs to prevent inadvertent entry whilst UV-C disinfection was in process. It took approximately 30-40 minutes to decontaminate rooms at 12,000  $\mu\text{Ws}/\text{cm}^2$  (for vegetative bacteria) and 60-90 minutes at the sporicidal setting (22,000  $\mu\text{Ws}/\text{cm}^2$ ) as shown in the table below.

	Room		Dose		Time taken	
	Surface Area (m <sup>2</sup> )	Volume (m <sup>3</sup> )	$\mu\text{Ws}/\text{cm}^2$	(mins)	$\mu\text{Ws}/\text{cm}^2$	(mins)
ITU Single Room A (1)	26	72	12,000	27	22,000	73
ITU Single Room A (2)	26	72	12,000	39		
ITU Single Room B	29	80	12,000	31		
ITU Single Room C	17	47	12,000	36		
ITU Single Room D	21	59	12,000	32		
ITU Single Room E	20	55	12,000	26		
ITU Single Room F	22	59	22,000	93	22,000	60
Operating theatre	42	126				
Stoke unit isolation room	16	39			22,000	23
Stoke unit ensuite bathroom	4	8			22,000	23

### Contact plates

Between 0-40 (median 10) colony forming units (cfu) per contact plate could be recovered from surfaces in the cleaned, unoccupied operating theatre. Following the use of the Tru-D unit (12,000  $\mu\text{Ws}/\text{cm}^2$ ) no organisms could be recovered from the environment (Figures 3 & 4).

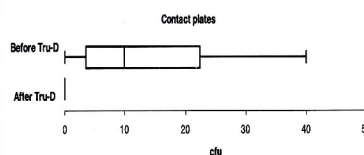


Fig 3: Box and whisker plot of the range of total aerobic cfu recovered from 15 replicate samples in an operating theatre before and after Tru-D

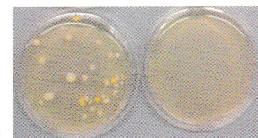


Fig 4: Contact plates before and after the use of Tru-D

### Seeded plastic Petri dishes

Tru-D demonstrated a high kill of MRSA both in line of sight (LOS) and shadow.  $\log_{10}$  reductions of VRE, MRA and *Aspergillus* were slightly lower in shadowed areas and at 12,000 compared to 22,000  $\mu\text{Ws}/\text{cm}^2$

	Dose	Mean $\log_{10}$ reduction	
		LOS*	Shadow
Operating theatre	MRSA 12,000	>4	>4
	VRE 12,000	3.6	2.4
ITU single room	VRE 12,000	4.2	2.3
	VRE 22,000	4.4	3.5
	MRA 12,000	>4	1.7
	MRA 22,000	>4	3.0
Aspergillus	12,000	4.0	2.0
	22,000	4.3	1.0

\*LOS = line of sight

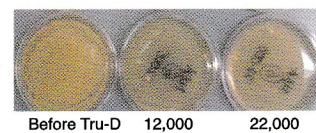
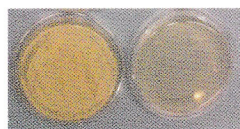
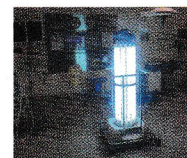


Fig 6: TSA contact plates from Petri dishes inoculated with MRA (above) and *Aspergillus* before after the use of Tru-D at 12,000  $\mu\text{Ws}/\text{cm}^2$  and 22,000  $\mu\text{Ws}/\text{cm}^2$



Before Tru-D 12,000

Fig 5: TSA contact plates from Petri dishes inoculated with MRSA before after the use of Tru-D at 12,000  $\mu\text{Ws}/\text{cm}^2$



## CONCLUSIONS

1. The Tru-D was easy to use and room disinfection times were relatively short. Without the need to inactivate room ventilation or smoke detectors, we were able to disinfect 3 ITU single rooms within 3 hours.
2. This device appears to achieve significant killing of key healthcare environmental pathogens including MRSA, VRE, MRA and *Aspergillus*.
3.  $\log_{10}$  reductions were lower within shadowed areas compared to areas directly within line of sight, and we would recommend using the Tru-D at a reflected dose setting of 22,000  $\mu\text{Ws}/\text{cm}^2$  for terminal room disinfection in most situations.

## ACKNOWLEDGEMENTS

We thank Rapid Disinfection Services Ltd for the free loan of the Tru-D unit