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Effectiveness of UV-C light irradiation on disinfection of an eSOS® smart toilet evaluated in a temporary settlement in the Philippines

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ABSTRACT

Ultraviolet germicidal (short wavelength UV-C) light was studied as surface disinfectant in an Emergency Sanitation Operation System® smart toilet to aid to the work of manual cleaning. The UV-C light was installed and regulated as a self-cleaning feature of the toilet, which automatically irradiate after each toilet use. Two experimental phases were conducted i.e. preparatory phase consists of tests under laboratory conditions and field testing phase. The laboratory UV test indicated that irradiation for 10 min with medium–low intensity of 0.15–0.4 W/m^2 could achieve 6.5 log removal of *Escherichia coli*. Field testing of the toilet under real usage found that UV-C irradiation was capable to inactivate total coliform at toilet surfaces within 167-cm distance from the UV-C lamp (UV-C dose between 1.88 and 2.74 mW). UV-C irradiation is most effective with the support of effective manual cleaning. Application of UV-C for surface disinfection in emergency toilets could potentially reduce public health risks.

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Introduction

People living in refugee camps are susceptible to displacement associated diseases such as diarrhoea, which may cause high morbidity and mortality rates (Connolly et al. 2004; Waring & Brown 2005; Kouadio et al. 2011). Diarrhoeal diseases are transmitted predominantly through the faecal–oral route. Safe excreta containment together with sufficient clean water supply and practise of proper hygiene, including hand-washing, are measures to intercept the transmission of diseases. Thus, the provision of safe sanitation is a life-saving response in the realm of emergencies.

Challenging environments which are often found in emergencies, such as densely populated areas, call for innovations in sanitation technical options (Bastable & Lamb 2012; Brown et al. 2012; Johannessen et al. 2012). The emergency Sanitation Operation System (eSOS) concept was presented as a promising alternative (Brdjanovic et al. 2015). The collection system, eSOS toilet, is a vital part of the eSOS concept. The toilet addresses the particular emergency requirements such as being easy to be transported, being made of durable materials, require minimum maintenance and do not require any excavation to install. The toilet is also advanced with unique features of having a smart monitoring

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