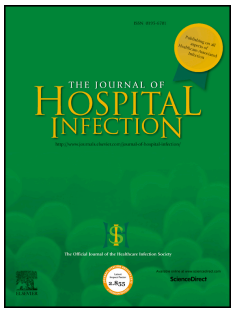
Accepted Manuscript



Preliminary study of the air quality in operating rooms: do textiles have a role?

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PII: S0195-6701(18)30224-X

DOI: 10.1016/j.jhin.2018.04.012

Reference: YJHIN 5410

To appear in: *Journal of Hospital Infection*

Received Date: 5 March 2018

Accepted Date: 10 April 2018

Please cite this article as: Totaro M, Porretta A, Canale A, Filippetti E, Tulipani A, Quattrone F, Giorgi S, Costa AL, Valentini P, Casini B, Privitera G, Baggiani A, Preliminary study of the air quality in operating rooms: do textiles have a role?, *Journal of Hospital Infection* (2018), doi: 10.1016/j.jhin.2018.04.012.

LETTER TITLE: Preliminary study of the air quality in operating rooms: do textiles have a role?

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Keywords: Air particulate matter, Healthcare Textiles, Operating Room, Surgical gown, Surgical Drape

Sir,

Although air quality control is routinely performed in operating rooms (ORs), and high efficiency particulate air (HEPA) filters ensure that ORs reach the required air standards (1), surgical textiles releasing inert particles, can worsen air quality (2, 3). Italian hospitals mostly use cotton drapes and disposable non-woven fabric (NWF) gowns. Cotton drapes are economic and reusable but release a high amount of inert particles. NWF and reusable technical textile (RTT) surgical drapes and gowns both release fewer particulates. However, NWF products, being disposable, have a higher impact on the environment than RTT ones that can be reused (4). We evaluated inert particulate levels and microbiological contamination in four ORs of an Italian teaching hospital after the exclusive use of NWF or RTT gowns and drapes. Technical features of the textiles are described elsewhere (4).

The study (August-October 2017) was performed in two abdominal surgery units (SU-A and SU-B) of a teaching hospital.

From each SU, tests were performed in two different 36 m^2 ORs, (OR-A1; OR-A2) (OR-B1; OR-B2), characterized by a conventional turbulent mixed flow (air flow rate of 3000 m^3/h) with high-efficiency particulate air (HEPA) filtering (5). Before the start of the study, in all the ORs healthcare personal wore NWF textiles. After the start of the trial, only RTT gowns and drapes were used in OR-A1 and OR-B1, while OR-A2 and OR-B2 were dedicated to the exclusive use of NWF.

Particle counts (0.5 and 5 μm) and microbiological sampling were performed before the surgical practices, at the centre and four corners of the room, whilst the ventilation systems were active.

0.5 μm particles were counted for the ISO class detection, as described by ISO 14644-1 (1), while the possible size of bacteria-carrying particles is 5 μm.

Particle counts were monitored in all the ORs at different times from the NWF/RTT introduction (T0=before 24 hours, basal condition; T1=after 24 hours; T2=after 72 hours; T3=after 7 days; T4=after 14 days; T5=7 days after reintroduction of NWF gowns and cotton drapes). Particle counts samplings were performed by the Hach Met One 3313 Particle Counter (Ashtead Technology, UK). Table I shows the particle counts found in SU-A and SU-B, with the respective ISO classification. Friedman statistical test and Nemenyi procedure were used to evaluate the particle count variation. Significant reductions of 0.5 μm particulate levels were observed at T2 and T4 in both ORs ($p=0.0003$; $p=0.0001$), while reductions in 5 μm particulate matter levels at T2, T3, T4 were observed in OR-A1 ($p=0.0008$; $p=0.0004$; $p=0.01$).

At T0; T3; T5, microbiological air sampling was performed at the corners and centre of the room using the Surface Air System (SAS) sampler (Microflow Aquaria, Italy), while four surfaces (bed, lamp, door, monitor) were sampled at the same times with Contact Agar Plates (VWR, Italy), as described elsewhere (6). Results showed the absence of pathogenic microorganisms. Total microbial counts at 22/37°C were always <1 CFU/m^3 (air) and <1 CFU/cm^2 (surfaces).

The aim of this study is to evaluate the effect of surgical textiles play a role. At basal condition, before the NWF/RTT introduction, a large difference in air quality between the two settings was observed. In SU-A air quality at T0 was suboptimal (ISO 6); this critical issue was immediately communicated to the Hospital Technical Unit. After the introduction of NWF and RTT, we assessed a significant decrease in air particulates at T2, T3 and T4, a non-significant increase at T1 and T3 and a significant increase at T5, after the reintroduction of cotton drapes. T0 was measured after the ORs have not been used in the previous two days so T5 probably better represents the basal condition of the ORs. In T4, after eleven days of use of low-lint textiles, the ORs could be

reclassified in the ISO 5 class. The exclusive use of NWF or RTT gowns and drapes was associated with a similar improvement of the air quality in the two ORs. These findings suggest that removal of cotton textiles can help reaching required standards in ORs.

In SU-B air quality at T0 was optimal (ISO 4) and a steady condition of air quality was observed during the study. Overall, no difference between NWF and RTT gowns and drapes was observed during the whole study; this may be due to the high-efficiency of the OR ventilation system. Arguably, differences between different textiles could be better assessed in an operating OR where many healthcare workers are present.

Within the limitations of this preliminary research (short period of study and absence of sampling during operations performed in operation) our data suggest that replacing traditional cotton surgical drapes with low-lint textiles like NWF or RTT might reduce inert particulate levels in surgical areas. Whether this would have any impact on infection rates is uncertain.

Competing Interests

All authors have no conflict of interest to declare.

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Table I: Descriptive statistic values about particle counts (0.5 and 5 µm) detected in operating rooms (ORs) at various times.

SURGERY UNIT	OR (textile type)	Particle counts (Mean, Standard Deviation; Median and ISO Class) at:[1]					
		T0	**T1**	**T2**	**T3**	**T4**	**T5**
A	**OR-A1 (RTT[2])**	**0.5µm** $1.6x10^4±5.3x10^2$ Median $1.6x10^4$ ISO CLASS 5.7 **5µm** $2.1x10^3±1.9x10$ Median $1.1x10^2$	**0.5µm** $1.7x10^4±1.4x10^4$ Median $9.7x10^3$ ISO CLASS 5.9 **5µm** 7.8x10±5x10 Median 7.1x10	**0.5µm** $5.7x10^3±6.8x10^2$ Median $3.4x10^3$ ISO CLASS 5.4 **5µm** 1.9x10±0.3x10 Median 0	**0.5µm** $1.5x10^4±3.6x10^3$ Median $1.4x10^4$ ISO CLASS 5.9 **5µm** 6.4x10±2x10 Median 3.6x10	**0.5µm** $3.1x10^3±1.4x10^3$ Median $3.1x10^3$ ISO CLASS 5.1 **5µm** 4.2x10±2x10 Median 3.5x10	**0.5µm** $4.2x10^4±1.2x10^4$ Median $4.2x10^4$ ISO CLASS 6.2 **5µm** $3.7x10^3±2x10$ Median $3x10^3$
	OR-A2 (NWF[3])	**0.5µm** $1.5x10^4±1.3x10^2$ Median $1.5x10^4$ ISO CLASS 5.6 **5µm** 9.6x10±9x10 Median 7.1x10	**0.5µm** $3.4x10^4±3.1x10^4$ Median $2.2x10^4$ ISO CLASS 6.3 **5µm** 9x10±8x10 Median 7.1x10	**0.5µm** $7x10^3±3.7x10^3$ Median $6.6x10^3$ ISO CLASS 5.5 **5µm** 7x0.1±0.07x10 Median 0	**0.5µm** $1.6x10^4±1.1x10^4$ Median $1.1x10^4$ ISO CLASS 5.9 **5µm** $3.9x10^2±2.1x10$ Median 3.6x10	**0.5µm** $4x10^3±1.2x10^3$ Median $4.1x10^3$ ISO CLASS 5.2 **5µm** 9.7x10±2.1x10 Median 7.1x10	**0.5µm** $1.3x10^4±1.1x10^4$ Median $9.1x10^3$ ISO CLASS 5.8 **5µm** 8.1x10±1.9x10 Median 7.1x10
B	**OR-B1 (RTT[2])**	**0.5µm** $1.3x10^2±1.2x10^2$ Median $1.1x10^2$ ISO CLASS 3.8 **5µm** 1.2x10±1x10 Median 0	**0.5µm** $5.4x10^2±3.1x10^2$ Median $4.2x10^2$ ISO CLASS 4.4 **5µm** 8.2x10±7.5x10 Median 3.6x10	**0.5µm** $1.3x10^2±1.1x10^2$ Median $1.1x10^2$ ISO CLASS 3.8 **5µm** 1.9x10±1x10 Median 0	**0.5µm** $2.6x10^2±2.1x10^2$ Median $1.4x10^2$ ISO CLASS 4.2 **5µm** 3.1x10±2.8x10 Median 0	**0.5µm** $8.9x10^26.6x10^2$ Median $7.5x10^2$ ISO CLASS 4.6 **5µm** $1.6x10^2±4.4x10$ Median 7.1x10	**0.5µm** $9x10^2±8.3x10$ Median 9x10 ISO CLASS 4 **5µm** 3.3x10±2.2x10 Median 0
	OR-B2 (NWF[3])	**0.5µm** $2.9x10^2±1.5x10^2$ Median $2.9x10^2$ ISO CLASS 4.1 **5µm** $1.1x10^2±8x10$ Median 7.1x10	**0.5µm** $6.7x10^2±4.1x10^2$ Median $6.4x10^2$ ISO CLASS 4.5 **5µm** $1.4x10^2±1.1x10^2$ Median $1.1x10^2$	**0.5µm** $1.6x10^2±1.2x10^2$ Median $1.6x10^2$ ISO CLASS 3.9 **5µm** 4x10±3.8x10 Median 3.5x10	**0.5µm** $3.1x10^2±1.3x10^2$ Median $2x10^2$ ISO CLASS 4 **5µm** 3.8x10±2.4x10 Median 3.5x10	**0.5µm** $7.4x10^2±2.7x10^2$ Median $7.4x10^2$ ISO CLASS 4.4 **5µm** $1.4x10^2±9x10$ Median $1.4x10^2$	**0.5µm** $2.5x10^2±1.1x10^2$ Median $2.5x10^2$ ISO CLASS 3.7 **5µm** 3.5x10±2.8x10 Median 3.5x10

Key:

[1]T0=before 24 hours, basal condition; T1=after 24 hours; T2=after 72 hours; T3=after 7 days; T4=after 14 days; T5=7 days after reintroduction of NWF gowns and cotton drapes

[2]RTT: reusable technical textile

[3]NWF: disposable non-woven fabric