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Long-term microbiological safety of the use of stacker cranes for storage and distribution of surgical and medical devices in operating theatres and intensive care units

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Long-term microbiological safety of using stacker cranes for storage and distribution of surgical and medical devices in operating theatres and intensive care units.

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Dear Editor,

I am very pleased to submit the manuscript entitled:

“Long-term microbiological safety of using stacker cranes for storage and distribution of surgical and medical devices in operating theatres and intensive care units.”
for publication in the *Journal of Hospital Infection* as a Letter to the editor.

In July 2022, we reported the use of a stacker crane for sterile storage in the operating theatre, a space – and cost saving alternative to a traditional sterile storage room. [1]. Nevertheless, owing to the lack of an EPA filter air handler and to the difficulty in properly cleaning inside the stacker crane, we claimed for a long-term monitoring to identify the putative accumulation of microorganisms.

Therefore, we performed a two-year study to address the safety of the stacker crane that stored the sterilized surgical devices. In addition, we evaluated the quality of the environment of a second stacker crane that stored and provided medical devices and consumables for the surgical and medical intensive care units.

Patients hospitalized in ICU are at risk for fungal superinfection, especially since the COVID pandemic: on the one hand, critically ill COVID-19 patients were at risk for aspergillus superinfection and in other hand national guidelines recommended to suspend the positive pressure inside the rooms of patients suffering from COVID. Our study showed that, if properly used, a stacker crane could contribute to the control of the environmental risk.

I certify that this article has not been submitted elsewhere for publication and that these data have not been previously published. I certify that all authors have read and approved the manuscript and that they contributed substantially to this work. I also certify that none of the authors have any conflicting interests related to this work and that no dedicated funding support was received for this study.

Thank you for your consideration.

Sincerely yours,

1. Faury H, Ducellier D, Cizeau F, Boquel F, Delaye C, Oudjhani M, et al. Using a stacker crane for sterile storage in the operating theatre: initial environmental microbiological qualification. *J Hosp Infect.* 2022;125:48-54.

1 **Long-term microbiological safety of using stacker cranes for storage and**
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3 **distribution of surgical and medical devices in operating theatres and**
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5 **intensive care units.**
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Sir,

In July 2022, we reported the use of a stacker crane for sterile storage in the operating theatre, a space – and cost saving alternative to a traditional sterile storage room [1]. Nevertheless, owing to the lack of an EPA filter air handler inside the stacker crane, we claimed for a long-term monitoring to identify the putative accumulation of microorganisms.

After the initial 3 months study, we performed at two-year monitoring to address the safety of the stacker crane that stored the sterilized surgical devices (SCSD). In addition, we evaluated the quality of the environment of a second stacker crane that stored and provided medical devices (SCMD) and consumables (gauze pads, infusion sets...) for the surgical and medical intensive care units (ICU). This SCMD spread over five floors (logistic floor, operating theater, logistic floor and the two medical and surgical ICU floors); it consisted of two juxtaposed vertical lift modules for a total volume of 357 m³ without air treatment. As for the SCSD, the loading and unloading zones of the SCMD were air-controlled (ISO 8 at rest). The loading zone was also at the logistical floor but there were three unloading zones: one in the operating theater and one at the medical and surgical intensive care floors. These two last unloading zones were localized in an air controlled closed room but unlike in the operating theater, the rooms faced a public corridor. The maintenance procedure and dressing policies were identical during the two periods. In the operating theater and ICUs, staff wore cloth outfits daily changed; headcap were worn only in the operating theater. As for the SCSD, the SCMD was disinfected through the same procedure on commissioning.

We compared the microbial contamination of the air and surfaces between the initial (January to March 2021) and the long-term following period (April 2021 to March 2023) inside the SCSD and the new SCMD. The same collecting, microbiological analysis and statistical methods were used [1]. Similarly, we evaluated and compared the microbial contamination of the air in the

1 loading and unloading zones of the SCSD and SCMD. During this 24-months following period,
2 we collected 127 air and 1257 surfaces specimens. The global air contamination in the SCSD
3 was stable and the percentage of sample with filamentous fungi decreased significantly (p
4 $=0,04$); this trend was confirmed from the surfaces samples that were less frequently
5 contaminated with fungi ($p= 0,007$) (Table 1). Therefore, we can assume that the staff took
6 ownership of the system and no drift in the practices occurred, i.e. the conditions of use and
7 maintenance. Regarding the SCMD, the air contamination was stable between the two
8 periods. However, the contamination of the surfaces (including the total flora and the
9 percentage of surface samples with a non-acceptable microbial contamination) increased
10 significantly ($p=0.005$ and $p=0.03$, respectively). This could be explained by different factors:
11 the higher volume of the SCMD, the origin of the articles that are placed in the SCMD (that
12 were from primary cardboard packaging), the higher number of unloading zone and the less-
13 controlled environment around the SCMD (lack of headcap carriage, proximity with a public
14 corridor). However, the fungal contamination in the air and on surfaces was stable and seemed
15 to be under control. Regarding the microbial air contamination in the loading and unloading
16 zones between the two periods for both the SCSD and SCMD, the evolution was non-significant
17 (data not showed). Nevertheless, 6/99 (6,1%) of air samples during the second period showed
18 the presence of *Aspergillus* sp., (2/50 and 4/49, for the SCSD and the SCMD, respectively) while
19 this fungal genus was absent from the air sample of the loading and unloading zones during
20 the first period study. The ISO 8 loading and unloading zones played their part in preventing
21 the internal fungal contamination of the stacker cranes, but the risk remains.

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54 Patients hospitalized in surgical and medical ICU are at risk for fungal superinfection;
55 the environment of ICU has been previously formally identified as a reservoir for aspergillus
56 contamination [2-5]. The COVID pandemic reinforced this issue: on the one hand critically ill
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1 COVID-19 patients were at risk for aspergillus superinfection and in another hand guidelines
2 recommended to suspend the positive pressure inside the rooms of patients suffering from
3 COVID [6,7]. This last measure aimed to protect the healthcare workers but exposed the
4 patient to the environmental contaminants from the corridor [7]. Next to adequate bio-
5 cleaning, the removing of cardboard packaging outside the ICU is one important preventive
6 measure for fungal environmental contamination: if properly used, a stacker crane could
7 contribute to the control of this risk.
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10 Besides confirming the long-term safety of stacker cranes in operating theatres, we
11 reported their contribution for the supply of medical devices for intensive care units. Their
12 microbial monitoring seems to us necessary for the early detection of practices drifts and
13 environmental contamination.
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31 **Conflict of interest statement**

32 The authors declare that they have no competing interests
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36 **Funding statement.**

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44 **References**

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Table 1. Long-term evolution of the stacker cranes' environmental microbiological contamination

	SCSD 1st period	SCSD 2nd period	P value	SCMD 1st period	SCMD 2nd period	P value
Air	n=36	n=77		n= 22	n= 50	
Total flora; CFU/m³ [Median [IQR]	16 [[8 – 28]	12 [6-22]	0,10	11 [8-24,5]	13 [6,5-22]	0,78
Fungal flora; CFU/m³ [Median – IQR]	0 [0 – 1]	0 [0-0]	0,01	0 [0-2]	0 [0-0]	0,18
Samples with a total flora value ≥ 100 CFU/m³ – no (%)	1 (2,8)	0 (0,0)	0,32	0 (0,0)	2 (4,0)	1
Samples with filamentous fungi – no (%)	9 (25,0)	7 (9,1)	0,04	11 (50,0)	17 (34,0)	0,29
Samples with colonies of <i>Aspergillus sp</i> – no (%)	3 (8,3)	1 (1,3)	0,09	1 (4,5)	7 (14,0)	0,42
Surfaces	n=359	n=767		n=225	n=490	
Total flora; CFU/25 cm² [Median – IQR]	8 [3 – 14]	7 [3-13]	0,12	9 [4-15,5]	12 [6 – 20]	0,005
Fungal flora; CFU/25 cm² [Median – IQR]	0 [0 – 0]	0 [0-0]	-	0 [0-1]	0 [0 – 0]	-
Samples with a total flora value ≥ 25 CFU/25 cm² – no (%)	23 (6,4)	42 (5,5)	0,58	29 (12,9)	96 (20,0)	0,03
Samples with filamentous fungi – no (%)	78 (21,7)	115 (15,0)	0,007	113 (50,2)	212 (43,3)	0,09

Samples with colonies of *Aspergillus sp* – 15 (4,2) 14 (1,8) 0,003 10 (4,4) 14 (2,9) 0,27
no (%)

SCSD: stocker crane for surgical devices, SCMD stocker crane for medical devices, 1st period: January to March 2021 ; 2nd period: April 2021 to March 2023.
CFU: colony-forming unit, IQR: interquartile range, no: number of. “-“ : not determined.
