Approbation of the administrative-territorial standards project

"Arrangement of events for ensuring of favorable conditions during staying and epidemiological safety of the environment in health care"

Section 2: Microbiological assessment of air cleaning devices Aero 1000 and Aero 700 "

Localization of the project: Petersburg City Hospital of St. George, 2 nd purulent-septic surgical department.

The study of air environment was conducted in:

1. Patient ward number 548 (installed device Aero 700);
2. Patient ward number 547 (without Aero installation);
3. Treatment room number 1 in the right wing (installed device Aero 1000);
4. Treatment room number 2 in the left wing (without device installation).

In the all patient wards chosen for the study 6 patients were hospitalized (males in old age, with different pathologies, according to the profile of septic surgical unit). Each of the wards had its own sanitary unit (shower, sink and toilet). In the wards there were beds, bedside tables, dining table, chairs, TV. The wards had one window; the area was as 25 m2 per chambers (volume 62.5 m3). Wet cleaning floors and surfaces in the wards was carried out once a day (5 working days) only by hospital staff (nurses) with the use of detergents.

The unit Aero 700 was permanently fixed in the ward to wall above patient bed, at a distance of 2 meters from the floor and 1 meter from the window. Treatment blocks consisted of two rooms: in entrance as dressing rooms (equipped with sink, trash and a desk for the registration of patients) and proper treatment room, where daily treatments were performed to patients after surgery. In the treatment room there were two beds for the patients, two cupboards for liquids and treatment solutions, surgical lamp, a table for instruments. Treatment block had space as 30 m 2, volume of 75 m3. Wet cleaning of floors and surfaces in the treatment blocks was done twice a day with use of detergents and disinfectants. Device Aero 1000 was installed in the treatment block on the table, at a distance of 1 meter off the couch for patients, at a height of 1 meter from the floor and 2.5 meters from the window.

Sampling of indoor air for bacteriological examination was carried out twice a day at 10 am and 2 pm, 6 points were selected in rooms with installed devices and 5 similar points (1-5) in areas without installed equipment (total 22 control points). The points' characteristic of air sampling in the wards and in the treatment block is presented in Table 1. As a result, the 9 bacteriological studies of air samples had been done at each point. In total, there were conducted 188 bacteriological studies of air samples.

Table 1

Characteristic of air sampling points in the wards and the treatment blocks

№	Name of sample point	Distance to the device, m	The total number of measurements
1. Treatment block № 1 (AEPO 1000)			
1.1	Windowsill	3,0	9
1.2	Cupboard for liquids	5,0	9
1.3	Patient couch	2,0	9
1.4	Table in pre-dressing room	6,0	9
1.5	Small table	1,0	9
1.6	Table with the installed device	0,5	4
Total air researches			49
2. Treatment block № 2			
2.1	Windowsill	-	9
2.2	Cupboard for liquids	-	9
2.3	Patient couch	-	9
2.4	Table in pre-dressing room	-	9
2.5	Small table	-	9
Total air researches			45
	3. Patient ward № 548 (AEPO 700)		
3.1	Windowsill	2,0	9
3.2	Bedside table	5,0	9
3.3	Dining table	3,0	9
3.4	Floor in toilet	6,0	9
3.5	Chair beside patient bed	2,0	9
3.6	TV Stand	0,5	4

Total air researches		49

4. **Patient ward № 547**			
4.1	Windowsill	-	9
4.2	Bedside table	-	9
4.3	Dining table	-	9
4.4	Floor in toilet	-	9
4.5	Chair beside patient bed	-	9
Total air researches			45
Total research in 4 areas			188

The study was carried out by air sedimentation method, using a seeding petri cups with culture medium (blood agar, vitelline-salt agar, Sabouraud agar, Wednesday, Endo). Petri cups with the above mentioned cultures was kept open for 10 minutes, then the crops were incubated 24 hours in an incubator at +37C and 24 hours at room temperature. After that the identification of microorganisms grown colonies to genus (or species) were counted and the number of microorganisms were determinated in 1 m3 of air.

During the bacteriological investigations of air samples the following indicators of microbial contamination were determined:

1. Total bacterial count (TBC)
2. Staphylococcus spp
3. Spore former
4. Coliforms
5. Pseudomonas aeruginosa
6. Molds

RESULTS

1. Analysis of microbial contamination of air samples in the wards

1.1. TBC (total bacterial count) – in the all air samples taken for bacteriological examination were found bacteria. Indicator TBC in 1 m3 of air in the ward № 548 with the installed device Aero 700 ranged from 704 to 832 KOE/m3. After the device installation and turn on the TBC rate ranged from 323 to 760 KOE/m3, and in the ward number 547 (where the device wasn't installed) - from 324 to 1024 KOE/m3r. Average values of TBC were 768, **326** and 677 KOE/m3, respectively. Thus, the installation of Aero 700 reduced the average TBC in the ward № 548 in 2,4 times after the installation and in 2,1 times in comparison with the ward № 547.

1.2. The bacteria of the genus Staphylococcus were found in all air samples collected for bacteriological examination. Number of Staphylococcus in 1 m3 of air in the ward № 548 fluctuated before the device Aero 700 installation from 498 to 624 KOE/m3, after the installation and turn on the device- from 213 to 333 KOE/m3 in the ward number 547 (where the device is not installed) – from 300 to 756 KOE/m3. Thus, the installation of Aero 700 reduced the content of Staphylococcus in the air of ward № 548 in 2,2 times, and in comparison with the ward № 547 in 2,2 times.

1.3. Spore-forming bacteria - were found in almost all air samples collected for bacteriological examination. Number of spore-forming bacteria in 1 m3 of air in the ward № 548 fluctuated before the device Aero 700 installation from 80 to 96 KOE/m3, after the installation and turn on the instrument - from 0 to 36 KOE/m3 in the ward number 547 (where the device is not installed) –from 88 to 152 KOE/m3. The average number was 92, 10 and 118 KOE/m3, respectively. Thus, the installation of Aero 700 reduced the content of spore-forming bacteria in the air of the ward № 548 in 9,2 times, and compared with the air of ward 547 in 11.8 times.

1.4. Enterobacteria, coliforms were found in some samples in the ward number 548 (before the installation of the device Aero 700) and in the ward number 547. An average of 4 and 5 KOE/m3, respectively. After switch on the device Aero 700 coliforms were not detected in any sample. Thus, the installation of Aero 700 reduced the content of coliforms in the air of

the ward № 548 more than in 4 times, and in comparison with the ward № 547 - more than in 5 times.

1.5. Pseudomonas aeruginosa - this microorganism has been detected in single samples only in the ward № 548 before the installation of the device Aero 700 and its average number was 8 KOE/m3 (range from 0 to 80 KOE/m3). During device operation in the ward number 548, as well as in air of the ward № 547 Pseudomonas aeruginosa wasn't detected in any sample. Thus, the installation of Aero 700 reduced the content of Pseudomonas aeruginosa in the air of the ward № 548 of more than in 8 times.

1.6. Fungis and molds - these microorganisms were detected in single samples only in the ward № 548 before the device installation. The average number was 50 KOE/m3 (range from 0 to 1040 KOE/m3). During the device operation in the ward number 548, as well as in the ward № 547 fungi and mold weren't detected in any sample. Thus, the installation of Aero 700 reduced the content of fungis and molds in air of the ward № 548 of more than in 50 times.

Opinion on the operation of the device Aero 700:

The device Aero 700 reduced the microbial contamination of air in the ward number 548, which was reflected in the reduction of all studied indicators of microbial air pollution: TBC, Staphylococcus, spore-forming microorganisms, coliforms, Pseudomonas aeruginosa and molds.

Aggregate data on the microbial contamination of air in the wards, as well as the average values of microbiological parameters are given in Tables 2 and 3.

Table 2.

Aggregate data on the microbial contamination of air in the patient wards (KOE / m 3)

№ points of air sampling	**Ward №548 (AEPO 700)**				**Ward № 547**	
	Before the installation		During operating		Without installation	
	Average value	Range of values	Average value	Range of values	Average value	Range of values

TBC						
1	960	560-1360	297	80-480	560	180-1680
2	1080	720-1440	201	120-248	687	240-1760
3	880	560-1200	404	220-480	997	240-1620
4	440	320-560	345	180-480	693	420-780
5	480	480-480	359	220-480	450	60-780
6	-	-	350	260-420	-	-
In total in the ward	**768**	704-832	**326**	323-760	**677**	324-1024
Staphylococcus						
1	615	480-750	269	80-360	387	180-640
2	550	480-620	214	120-340	443	160-660
3	800	480-1120	260	200-380	917	120-1800
4	440	320-560	231	160-380	647	420-800
5	400	320-480	279	220-452	427	60-720
6	-	-	290	200-360	-	-
In total in the ward	**561**	498-624	**257**	213-333	**564**	300-756
Spore-forming bacteria						
1	140	80-200	0	0	120	80-240
2	200	160-240	9	0-60	97	60-160

3	40	0-80	23	0-60	120	80-160
4	0	0	19	0-60	106	80-160
5	80	0-160	11	0-40	147	80-240
6	-	-	0	0	-	-
In total in the ward	**92**	80-96	**10**	0-36	**118**	88-152
Coliforms						
In total in the ward	**4**	0-9	**0**	0	**5**	0-12
Pseudomonas aeruginosa						
In total in the ward	**8**	0-80	**0**	0	**0**	0
Fungis and molds						
In total in the ward	**50**	0-1040	**0**	0	**0**	0

Table 3.

Average values of microbial indicators of microbial contamination of air in the wards

Microbiological indicators	**Ward № 548 (AEPO 700)**		**Ward № 547**	Reduction of microbial contamination in the ward № 548 as compared	
	Before the device installation	During operating	Without device installation	In comparison with the ward № 548 before the installation	In comparison with the ward № 547
1.TBC	768	327	677	in 2,3 times	in 2,2 times
2. Staphylococcus	561	257	564	in 2,2 times	in 2,2 times
3. Spore-forming bacteria	92	10	118	In 9,2 times	in 11,8 times
4. Coliforms	4	0	5	More than in 4 times	More than in 5 times
5. Pseudomonas aeruginosa	8	0	0	More than in 8 times	-
6. Fungis and molds	50	0	0	More than in 50 times	-

2. Analysis of microbial contamination of air samples in the treatment blocks

2.1 TBC microorganisms were detected in all taken for bacteriological examination of the air samples. Indicator TBC (total bacterial count) in 1 m3 of air in the treatment block number 1 before the device Aero 1000 installation ranged from 180 to 216 KOE/m3. After the installation and turn on the TBC rate ranged from 50 to 90 KOE/m3, and in the treatment block number 2 (where the device wasn't installed) - from 260 to 372 KOE/m3. Average values TBC were 198, 68 and 309 KOE/m3, respectively. Thus, the installation of Aero 1000 reduced averagely TBC in the treatment block number 1 in 2,9 times, and compared with the block number 2 – in 4,5 times.\

2.2 Staphylococci - the bacteria of the genus Staphylococcus were found in all air samples collected for bacteriological examination. Number of Staphylococcus in 1 m3 of air in the treatment block number 1 before the device installation, ranged from 152 to 192 KOE/m3, after

the installation and turn on the device - from 30 to 72 KOE/m3, in the treatment block number 2 (where the device wasn't installed) - from 180 to 360 KOE/m3. Average number of Staphylococcus was 172, 50 and 291 KOE/m3, respectively. Thus, the installation of Aero 1000 reduced the content of Staphylococcus in the air of the treatment block number 1 in 3,4 times, and compared with the treatment block number 2 - in 5,8 times.

2.3 Spore-forming bacteria - were found in some air samples. Average number of spore-forming bacteria in 1 m3 of air in the block number 1 before the device installation was 16 KOE/m3 (constant rate), after the installation and switch on - 7 KOE/m3 (range from 0 to 36 KOE/m3) in the treatment block number 2 (where device wasn't installed) – 18 36 KOE/m3 (range from 0 to 48 KOE/m3). Thus, the installation of Aero 1000 reduced the content of spore-forming microorganisms in the air of the treatment block number 1 in 2,3 times, and in comparison with the treatment block number 2 - 2,6 times.

2.4 Coliforms, Pseudomonas aeruginosa, as well as fungi and molds - were not detected in any sample of air taken in the treatment block number 1 and number 2.

Opinion on the operation of the device Aero 1000:

In general, the air in the treatments blocks is characterized by less microbial contamination than air in the patient wards. The device Aero 1000 reduced the microbial contamination of the air in the treatment block 1, which was reflected in the reduction of indices of microbial pollution: TBC, Staphylococcus, and spore-forming microorganisms.

Summary data on microbial air pollution in the treatments blocks, as well as average values of microbiological parameters are given in Tables 4 and 5.

Table 4.

Summary data on microbial air pollution in the treatment blocks (in KOE / m 3)

№ points of air sampling	**Treatment block №1 (AEPO 1000)**				**Treatment block №2**	
	Before the installation		During operating		Without installation	
	Average value	Range of values	Average value	Range of values	Average value	Range of values
TBC						
1	240	240	60	0-120	327	160-420
2	120	120	83	60-160	287	120-480
3	180	120-240	80	60-120	317	120-640
4	210	180-240	63	60-80	303	160-480
5	240	240	74	60-120	310	120-420
6	-	-	50	0-80	-	-
Total in the treatment block	**198**	180-216	**68**	50-90	**309**	260-372
Staphylococcus						
1	180	120-240	37	0-180	220	80-420
2	120	80-160	66	60-80	310	180-480
3	200	160-240	49	0-180	273	120-400
4	280	240-320	60	0-120	287	120-480
5	80	80-80	54	0-120	363	120-640

6	-	-	35	0-80	-	-
Total in the treatment block	**172**	152-192	**50**	30-72	**291**	180-360
Spore-forming bacteria						
Total in the treatment block	**16**	16-16	7	0-36	**18**	0-48
Total in the treatment block	Coliforms - weren't detected					
Total in the treatment block	Pseudomonas aeruginosa – weren't detected					
Total in the treatment block	fungi and molds – weren't detected					