RAPPORT

Evaluation of a cleaning method

A study of floor cleaning with Twister™ cleaning pads at Danderyd Hospital

For HTC AB

Ann-Beth Antonsson
Professor

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IVL Swedish Environmental Research Institute

Box 21060, SE-100 31 Stockholm
Valhallavägen 81, Stockholm
Tel: +46 (0)8 598 563 00
Fax: +46(0)8 598 563 90

Box 5302, SE-400 14 Göteborg
Aschebergsgatan 44, Göteborg
Tel: +46 (0)31 725 62 00
Fax: + 46 (0)31 725 62 90

www.ivl.se

Summary

HTC AB has commissioned IVL to evaluate how a change in cleaning method influences the cleanliness and the amount of bacteria/microorganisms on floors, dust levels in the air and workload for the cleaners. The evaluation, which was undertaken during the period 23rd November 2009 to 5th February 2010, will be used as input in the cleaning service procurement process for Danderyd Hospital.

The goal was to compare two methods of cleaning in three different applications.

	New chemical free method	**Current method**
Daily cleaning by machine	Green Twister™ pad with scrubber drier machine and water.	Red 3M pad with scrubber drier machine and detergent.
Machine cleaning 1-2 times per week and daily mopping	Machine cleaning with green Twister™ and water twice a week. Daily mopping with dry microfiber mop.	Machine cleaning with water 1-2 times per week. Daily mopping with detergent.
Daily mopping	Deep cleaning with Twister and dry microfiber swab thereafter.	Mopping with detergent.

The evaluation gave the following results:

Daily machine cleaning
Cleaning with the new chemical free method improved the cleanliness by 35 % and decreased the amount of bacteria by 61 % on average. The improvement is statistically significant.

Cleaning with the current method improved the cleanliness by 19 % and decreased the amount of bacteria by 29 % on average. This improvement was **not** statistically significant. It should be noted that three out of four measurements showed an increase in number of microorganisms after cleaning.

Conclusion: The new chemical free method with water and Twister™ resulted in better cleanliness and considerably fewer bacteria in daily machine cleaning than the current method where antibacterial detergents are used.

Machine cleaning 1-2 times per week and daily mopping
The new chemical free method resulted in a 21% improvement in cleanliness and 80% less bacteria after cleaning compared to before cleaning. These results were statistically significant.

The current cleaning method resulted in an improvement in cleanliness of 27% at the beginning of the measurement period (statistically significant). At the end of the cleaning period, the floor was found to be cleaner before cleaning than after cleaning with the current method but this result was not statistically significant. The amount of bacteria was on average 25% lower after cleaning but this result was not statistically significant. (Of the eight cleaning events studied, the amount of

bacteria was lower after cleaning on two occasions, unchanged on three occasions and higher on three occasions.)

Conclusion: In a schedule consisting of machine cleaning 1-2 times per week and mopping on all other days, the new chemical free method resulted in considerably less bacteria than the current method. It is not possible to draw any conclusions regarding differences in the cleanliness resulting from the two methods.

Daily mopping
Neither the new nor the current cleaning method resulted in a change in cleanliness after daily mopping. The amount of bacteria was also unchanged for the new cleaning method. The amount of bacteria was at a low and stable level with the new cleaning method. However, the current cleaning method resulted in increased amounts of bacteria on five of the eight occasions studied.

Conclusion: Using the Twister™ to deep clean a floor appears to have long term effect on the amount of bacteria; the amount of bacteria remains on a steady, low level. This conclusion is based on relatively few measurements and should therefore be treated cautiously.

Dust levels
The amount of particles with a diameter greater than 1 μm was found to be slightly higher with the new cleaning method, both in rooms and in corridors, compared to the current method. This increase is, however, small and builds on a very low level found in the current method.

Friction
The friction encountered when a mop is swept across the floor was measured. Floors that were cleaned with Twister™ had a uniform and low level of friction (0.4-1.1 N). Floors that were cleaned using the current method had greater friction (0.8-3.3 N). Lower friction is likely to result in lower load for cleaners if the floor is cleaned with a mop.

Deep cleaning
Deep cleaning is achieved considerably faster with Twister™ (1.3 minutes per $m^{2)}$ than with the current method of deep cleaning (12.8 minutes per m^2).

Chemical usage
The use of chemicals is completely eliminated with Twister™. The current method uses 0.83 dl/m^2 during deep cleaning. No data are available on the amount of chemicals used in ordinary cleaning with the current method, but the reduction is likely to be considerable since this concerns daily cleaning.

In environments where many stains appear on the floor and where daily cleaning is mainly dry mopping, extra efforts are often needed and some form of wet treatment is necessary to remove the stains.

Contents

1 Background

HTC AB has commissioned IVL to evaluate how a change in cleaning method influences the cleanliness and the amount of bacteria/microorganisms on floors, dust levels in the air and workload for the cleaners.

The evaluation was undertaken during the period 23rd November 2009 to 5th February 2010.

2 Aims

The study aimed to improve understanding of, and to compare two alternative cleaning methods in preparation for a procurement process for cleaning services at Danderyd Hospital. It is of particular interest to evaluate the effects of the use of Twister™.

The evaluation also aimed to provide background data which could support a decision to make specific demands on cleaning service providers regarding the types of cleaning materials or cleaning methods used. The aims would be to improve the quality of floor care provided by cleaning services at the same, or even a lower cost than previously and also to reduce the use of cleaning chemicals.

3 Method

3.1 The project team

Robert Kreicberg, Sales and Marketing Director at HTC Sweden AB was the project manager for the evaluation.

Project team members and their responsibilities were as follows.

Responsibility for planning and compilation of the evaluation.
Ann-Beth Antonsson Professor, IVL Swedish Environmental Research Institute.

Measurement of cleanliness and bacteria/microorganisms as indicators for the overall cleaning result. Method selection, implementation and compilation of results.
Bengt Christensson Industrial hygienist, IVL Swedish Environmental Research Institute
Gabriella Östlund Master of engineering, IVL Swedish Environmental Research Institute
Aime Must Microbiologist, IVL Swedish Environmental Research Institute

Measurement of dust levels as an indicator of the overall cleaning result. Method selection, implementation and compilation of results.
Pär Fjällström Ph.D., IVL Swedish Environmental Research Institute.

Evaluation of workload. Method selection, implementation and compilation of results.
Lisa Schmidt M.A., IVL Swedish Environmental Research Institute.

Contacts involved in planning of the evaluation, and supplied contacts in the relevant hospital departments.
Magnus Karlsson Department manager, Danderyd hospital
Sigrid Wahlberg Cleaning controller, Danderyd hospital

Documentation of cleaning methods used in the study.
Thomas Johansson Delsec AB

Introduction and training in use of the Twister™ for cleaning.
Kjell Svensson Bevara AB

3.2 Premises

Danderyd hospital has allowed the use of one hospital ward and an entrance hall for the evaluation project.

One corridor and one room in ward 61, house 20, 6th floor were used in the evaluation. The floors are polish coated linoleum floors.

The entrance hall on the 2nd floor was also used. It is an entry point for emergency cases and for people walking in from the street. The floor is plastic.

3.3 Cleaning methods

Two cleaning methods have been studied in the evaluation. They are referred to as the "current cleaning method" and the "new cleaning method". The aim was to compare the two methods in three different applications.

	New cleaning method	**Current cleaning method**
Daily machine cleaning	Green Twister™ pad with scrubber drier machine and water.	Red 3M pad with detergent and scrubber drier machine.
Machine cleaning 1-2 times per week and mopping on the other days	Machine cleaning with green Twister™ and water twice a week. On the other days, mopping with dry microfiber mop.	Machine cleaning with water 1-2 times per week. On the other days, mopping with detergent.
Daily mopping	Deep cleaning with Twister and dry microfiber mop thereafter.	Mopping with detergent.

Before starting to clean with the new method, the floor in the study area was deep cleaned. This was not done in the entrance hall. The floor was deep cleaned with Twister™, see Appendix 4. For

comparison, a floor has been deep cleaned with the current method for deep cleaning; including the application of polish, see Appendix 5.

3.3.1 The new cleaning method

The new cleaning method is based on the Twister™ cleaning system from HTC Sweden AB and dry microfiber mopping. According to the manufacturer, Twister™ is a new cleaning system consisting of cleaning pads that contain billions of microscopic diamonds that clean the floor mechanically instead of chemically.

The Twister™ system is dependent on mechanical cleaning equipment. It can be used as the sole cleaning method or can be used in combination with microfiber mops. The entrance hall was cleaned with a scrubber drier machine equipped with a Twister™ pad. On the hospital ward, the combination of scrubber drier machine with Twister™ and microfiber mop with cleaning fibres made of composite was used.

No chemicals were used with the Twister™ in the scrubber drier machine; only water was added.

3.3.2 The current cleaning method

The current cleaning method consists of mopping with a damp microfiber mop and machine cleaning in the corridors and the entrance hall on the 2nd floor. A cleaning machine equipped with a red 3M pad and with only water (no chemicals) is used once a week. According to the cleaning entrepreneur, Rengörare Näslund, no detergent is needed with the cleaning machine because so much is used in wet mopping on 6 days per week that it is not necessary to add any more chemicals. In their opinion, a "chemical film" forms on the floor. This is scrubbed away once a week with the scrubber drier machine.

The microfiber mops are cleaned in a washing machine at 90 degrees. During the last rinse, the mops are impregnated with Taski Jontec Tensol.

The entrance hall was cleaned with a machine equipped with a red 3M pad and Gipeco Hågeren cleaning agent, which is an alkali, low foaming all round agent with antibacterial properties.

A comprehensive description of the current and new cleaning methods can be found in Appendix 1.

3.3.3 Deep cleaning

Deep cleaning is an occasional task, for example undertaken annually. It is a particularly thorough clean of the floor, sometimes in combination with the application of new polish.

Deep cleaning with Twister™ (the new method) was achieved firstly by scraping the corners of the floor to remove loose polish and dirt. Then the floor was lightly scrubbed with a red Twister™ pad. The water left on the floor was cleared with a wet vacuum and then dried with a green Twister™ pad.

Deep cleaning with the current method is described in more detail in Appendix 5 and consists of soaking, manual scrubbing, application of polish and other tasks in a process consisting of 11 steps.

3.3.4 Training in the new method for cleaners

At the beginning of the study period, two people were trained in the new cleaning method: the cleaner responsible for the hospital ward and entrance hall in the study and a stand-in, employed by Rengörare Näslund. The training involved an explanation of how the Twister™ and dry microfiber mop should be used and an introduction to the materials used and their function.

The training was given by Kjell Svensson, Bevara, in collaboration with Robert Kreicberg, HTC Sweden AB.

3.4 Implementation

The evaluation was undertaken as follows:

Cleaning was undertaken at three locations: one room and one corridor in a ward and one entrance hall. In the entrance hall (2nd floor), the current method was used until 23rd November 2009 and thereafter the new method was used. On the ward, the current method was used for approximately one month, 1st December 2009 – 6th January 2010 and thereafter the new method was used 7th January – 5th February 2010.

Two measurements were made of the current cleaning method on the ward: one at the beginning and one at the end of the period. Likewise, two measurements were made of the new cleaning method: at the beginning and end of the period. The results of the current method were used to compare with the new method.

In the entrance hall on the second floor one measurement was made of the current method. Thereafter two measurements were made of the new method: one at the beginning and one at the end of the study period.

The measurements monitored:

- cleanliness of the floor
- bacteria/microorganisms on the floor
- dust levels in the air (only undertaken on the ward, not in the entrance hall).

Furthermore, the following was also measured

- friction for a mop swept across the floor (only undertaken on the ward, not in the entrance hall).

The friction measurements were made after cleaning with the current method on the 18th December 2009, and after cleaning with Twister™ on the 4th February 2010. On ward 61, three measurements were made in the corridor and three in a room.

Using the results of these measurements, the effects of the cleaning methods on cleanliness, presence of bacteria/microorganisms, dust levels and heaviness of the cleaning work (friction) were evaluated. In the original study outline, pulse measurements were also planned to be undertaken as a measure of the heaviness of the work. These measurements were, however, not undertaken, for reasons explained in the discussion below.

The measurement methods are described in detail in Appendix 6.

4 Results

The measurement results are summarized below. Detailed results from the measurement of cleanliness, bacteria/microorganisms and dust levels are reported in Appendix 2 (cleanliness and microorganisms) and Appendix 3 (dust levels).

4.1 Cleanliness and microorganisms

The results of the measurement of cleanliness and bacteria/microorganisms are shown in Table 3 (for the entrance hall), Table 4 (for the corridor) and Table 5 (the ward room).

During the sampling process it was discovered that fragments of old polish came loose from the floors in the corridor and in the room. Some samples could not be analysed because of polish fragments. The number of samples taken in each location was increased in order to compensate for the need to reject some samples.

Table 3. Measured values (mean value and 95% confidence interval) for cleanliness and bacteria/microorganisms in the **entrance hall**. The new method consists in this case of cleaning with Twister™ (no microfiber mopping).

Entrance hall, 2nd floor				
	Current method			
Measurement	Before cleaning	After cleaning	**Change**	**Significance**
Cleanliness	2.6±1.1	2.1±1.1	**-19 %**	Not significant
Bacteria	8.5±9.1	6.0±3.5	**-29 %**	Not significant
	New method			
Measurement	Before cleaning	After cleaning	**Change**	**Significance**
Cleanliness	2.5±0.5	1.6±0.4	**-35 %**	Significant (99 %)
Bacteria	3.8±1.5	1.4±1.1	**-61 %**	Significant (96 %)

Table 4. Measured values for cleanliness and bacteria/microorganisms in the **corridor, ward 61**. The corridor was cleaned using Twister™ two times per week and with a dry microfiber mop on the other days. Mean values (and 95 % confidence intervals) are based on the measurements for which both the samples before and after cleaning were free from polish fragments.

		Current method			
Time	Measurement	Before cleaning	After cleaning	**Change**	**Significance**
Start of the period	Cleanliness	2.6±1.2	1.9±1	-27 %	Significant (94 %)
	Bacteria	4±2	3±2	-25 %	Not significant
End of the period	Cleanliness	5.0±1.9	5.6±2.1	12 %	Not significant
	Bacteria	4±4	3±1	-25 %	Not significant
		New method			
Time	Measurement	Before cleaning	After cleaning	**Change**	**Significance**
Start of the period	Cleanliness	-	3.7±0.8	-	-
	Bacteria	-	1±0	-	-
End of the period	Cleanliness	3.3±1	2.6±0.9	-21 %	Significant (94 %)
	Bacteria	5±1	1±1	-80 %	Significant (99 %)

Table 5. Measured values for cleanliness and bacteria/microorganisms in **room 8, ward 61**. The corridor was deep cleaned using Twister™ but was then cleaned solely with a dry microfiber mop. Mean values (and 95 % confidence intervals) are based on the measurements for which both the samples before and after cleaning were free from polish fragments.

Room 8, ward 61					
		Current method			
Time	Measurement	Before cleaning	After cleaning	**Change**	**Significance**
Start of the period	Cleanliness	3.0±2.5	2.4±2.6	**-20 %**	Not significant
	Bacteria	4±1	34±22	**750 %**	Significant (92 %)
End of the period	Cleanliness	4.7±1.7	5.4±3.3	**15 %**	Not significant
	Bacteria	14±17	14±20	**± 0 %**	Not significant
		New method			
Time	Measurement	Before cleaning	After cleaning	**Change**	**Significance**
Start of the period	Cleanliness	-	2.7±1.1	**-**	-
	Bacteria	-	0±0	**-**	-
End of the period	Cleanliness	2.0±1.4	3.1±4.8	**55 %**	Not significant
	Bacteria	2±1	2±1	**□ 0 %**	Not significant

Table 6. Overview of mean cleanliness (including 95 % confidence intervals) **after cleaning** with the current cleaning method and Twister™.

Mean cleanliness after cleaning				
Place/period	Current cleaning method	Twister™	Twister™ and dry microfiber mop	Twister™ Deep cleaning, dry microfiber mop
Entrance hall, start of cleaning period	2.1±1.1	1.2±0.5		
Entrance hall, end of cleaning period		1.8±0.5		
Entrance hall, total	**2.1±1.1**	**1.6±0.4**		
Ward 61, corridor, start of cleaning period	1.9±1		3.7±0.8	
Ward 61, corridor, end of cleaning period	5.6±2.1		2.6±0.9	
Ward 61, corridor, total	**4.1±1.5**		**3.3±0.6**	
Ward 61, room, start of cleaning period	2.4±2.6			2.7±1.1
Ward 61, room, end of cleaning period	5.4±3.3			3.1±4.8
Ward 61, room, total	**4.4±2.4**			**2.7±1.1**

Tables 3-5 show that the measurements of cleanliness and bacteria/microorganisms are lower after cleaning with Twister™ than with the current method. Table 6 provides a comparison of mean cleanliness after cleaning with the two methods. Table 7 provides the corresponding results for bacteria.

The results shown in the tables above and in Table 7 suggest that both cleaning schedules -daily cleaning with Twister™ and cleaning with Twister™ twice a week and dry mopping on the other days – result in considerably better cleanliness, measured as the quantity of particles and the bacteria/microorganisms found on the floor, compared to the current cleaning method of mopping with a damp microfiber mop. The comparison of the current and new method was tested with the t-test. The results are presented in Table 8.

Table 7. Overview of quantity of microorganisms remaining (mean and 95 % confidence interval) after cleaning with the current cleaning method and with Twister™.

Average count of bacteria/microorganisms after cleaning				
Location/period	Current cleaning method	Twister™	Twister™ and dry microfiber mop	Twister™ Deep cleaning, dry microfiber mop
Entrance hall, start of cleaning period	**6±3.6**	1±0.8		
Entrance hall, end of cleaning period		2±2		
Entrance hall, total		**1.4±2.3**		
Ward 61, corridor, start of cleaning period	3±2		1±0	
Ward 61, corridor, end of cleaning period	3±1		2±1	
Ward 61, corridor, total	**3.1±1.1**		**1.1±1.1**	
Ward 61, room, start of cleaning period	34±22			0±0
Ward 61, room, end of cleaning period	14±20			2±1
Ward 61, room, total	**24±16**			**1.1±1.1**

Table 8. Measured values (mean and 95 % confidence interval) for cleanliness and bacteria/microorganisms **after cleaning**, comparison of the current method and Twister™.

Type of cleaning	Location	Measurement	Current	Twister™	**Change**	Significance
Daily cleaning	Entrance hall	Cleanliness	2.1±1.1	1.3±0.4	**-38 %**	Not significant
		Bacteria	6±3	1±0	**-83 %**	Significant (94 %)
Deep cleaning	Corridor	Cleanliness	1.9±1	3.7±0.8	**+97 %**	Significant (97 %)
		Bacteria	3.3±2	1±0	**-69 %**	Significant (88 %)
	Room	Cleanliness	2.2±0.4	2.7±1.1	**+20 %**	Not significant
		Bacteria	34±22	0±0	**-100 %**	Significant (95 %)
Daily cleaning	Corridor	Cleanliness	5.3±1.6	2.4±0.7	**-55 %**	Significant (99.7 %)
		Bacteria	3.0±1.4	1.1±1.3	**-63 %**	Not significant
	Room	Cleanliness	5.4±2.2	2.9±2	**-47 %**	Significant (88 %)
		Bacteria	14±20	2.3±1.5	**-84 %**	Not significant

4.2 Particle levels in the air

The particle levels on ward 61 are summarized in Table 9. The values in the table are the particle count over and above the count in the intake air. This means that the values in the table reflect the additional particles that arise from the activities on the premises, including those from cleaning and any particles that are resuspended after inadequate cleaning.

The particle measurements were undertaken on three days. Table 6 shows the mean values and 95 % confidence interval on these days. Occasionally, high concentrations ("spikes") were measured in the room and corridor on days when the new cleaning method was implemented. Mean dust levels have been calculated both with and without the inclusion of these spikes. In the table below the results where these spikes are rejected is labelled "Adjusted".

A statistical analysis shows that the amount of larger particles was significantly (t-test) higher after cleaning with the new cleaning method than with the current method. The difference was not statistically significant for smaller particles, less than 0.3 µm.

Table 9. Mean and 95 % confidence intervals for particle levels during the measurement period (corrected for background levels). A negative value means that the level of particles in the intake air was higher than the level measured on the premises.

Sampling point	**Cleaning method**	**Particle level, count/l**		
		>0.30 µm	>1.0 µm	>5.0 µm
Room	Current cleaning method, impregnated damp mop	-1650±139	39±1	3±0.2
Room	New cleaning method, dry mop after deep cleaning with Twister™	-1605±963	71±7	5±0.3
Room	New cleaning method (Adjusted)	-4577±138	49±2	5±0.3
Corridor	Current cleaning method, cleaning with machine and water 1-2 times/week, mopping with impregnated damp mop on all other days	1485±111	89±3	7±0.3
Corridor	New cleaning method, machine cleaning with Twister™ and water 2 times/week, daily dry mopping on all other days	7250±418	349±43	42±7
Corridor	New cleaning method, Twister™ (Adjusted)	5896±347	137±7	11±1

4.3 Friction

The results of the friction measurements are shown in Table 10. Friction measurements were made after cleaning with the current cleaning method on 18th December 2009. Measurements were made on 4th February 2010 on floor that had been cleaned with Twister™ (corridor measurements) and that had been deep cleaned with Twister™ one month earlier and subsequently cleaned with a dry microfiber mop (room measurements). The friction measurements were repeated three times for each measurement point.

Table 10. Results of the friction measurements with a dynamometer. Values in Newton (N), mean, 95 % confidence interval, after cleaning with the current method and after deep cleaning and cleaning with Twister™

	Room 8		Corridor, near end		Corridor, middle		Corridor, far end	
	Current	Twister™	Current	Twister™	Current	Twister™	Current	Twister™
Mean	1.2±0.5	0.4±0.0	1.4±0.7	0.8±0.6	0.8±0.2	0.7±0.3	3.3±2.3	1.1±0.1
Difference	**-67 %**		**-43 %**		**-13 %**		**-67 %**	
Significance	Significant (93 %)		Not significant		Not significant		Not significant	
Difference, total	**-**		**-52 %**					
Significance	-		Significant (88 %)					

The friction level of the floor that was cleaned with Twister™ was low and relatively consistent (0.4-1.1 N). The friction level was higher for the floor cleaned with the current cleaning method (0.8 -3.3 N). Lower friction is likely to result in a reduced work-load for the cleaner when mopping the floor.

4.4 Time taken for deep cleaning/floor care

The method and time taken to deep clean a floor with Twister™ is reported in Appendix 4. The corresponding information for the current floor care method is found in Appendix 5.

It was considerably faster to deep clean the floor with Twister™ compared to the current method for floor care. The treatment with Twister™ took around 1.3 minutes per m^2 compared with 12.8 minutes for the current deep clean method. The use of chemicals was completely eliminated with Twister™. The current method used 0.83 dl/m^2.

5 Discussion

5.1 The subject of the evaluation

This study has evaluated cleaning methods and compared the currently used method (damp microfiber mop and cleaning machine) with a new cleaning method (dry microfiber mop and cleaning machine with Twister™ pad).

The measurements made reflect the effects of these cleaning methods on the amount of particles and bacteria on the floor, particles in the air and floor friction.

It is important to make a distinction between the effects of the use of Twister™ and the effects of the use of a dry microfiber mop instead of a damp one. In this evaluation, Twister™ has been combined with dry mopping. It is, however, possible to combine the use of Twister™ with other mops and cleaning techniques.

5.2 Reliability of the results

Good methodology and sufficient data is vital in order to be able to make a reliable evaluation. The project plan therefore specified that several samples should be taken in order to be able to judge the reliability of the results in relation to the variability of, for example, cleanliness, bacteria levels and dust levels.

During the evaluation it was discovered that several samples, in particular from ward 61, had to be rejected because they contained fragments of polish that had come loose from the floor. The polish contaminated several samples and therefore resulted in misleading results. Therefore, the number of samples taken was increased, in order to compensate for the rejected samples.

Several of the measurements indicate that there is large variation in the measurement results, especially measurements of the current cleaning method. This complicates the evaluation. If the variation in values is large then more samples are necessary to demonstrate a statistically significant difference. In several cases we see that the variation, for example in the amount of bacteria, is relatively small in samples after cleaning with Twister™, but that it is much greater in samples after cleaning with the current method. A statistical analysis shows that the difference is not significant. Our assessment is that it is nonetheless reasonable to draw the conclusion that a difference does exist and that it would be statistically significant if more samples had been taken.

5.3 Effects on the cleanliness and amount of microorganisms on the floor

The measurements that most clearly show the effects of cleaning with Twister™ are those in the entrance hall. In this location, all floor cleaning was done with a cleaning machine, equipped either with a Twister™ pad or a conventional cleaning pad.

Table 3 shows that after daily cleaning in the entrance hall with Twister™, the cleanliness was 35% better regarding particles and 61% better regarding microorganisms. The current cleaning method showed no significant improvement in cleanliness regarding particles or microorganisms in a comparison of before and after cleaning.

The measurements in the corridor of the ward were heavily affected by the presence of fragments of polish and the results were ambiguous, see Table 4. However, measurements at the end of the cleaning period show that the floor was significantly cleaner (21%) with less bacteria (80%) using the Twister™ than using the current method.

Cleaning with Twister™ at least two times per week (see Table 4) lead to considerably better results than deep cleaning with Twister™ followed by daily mopping with a dry microfiber mop (see Table

5). The bacteria levels were low and stable with the latter method. The number of samples was, however, limited and this result is therefore not statistically significant and should be interpreted with caution.

Table 8 compares the cleanliness and bacteria levels after cleaning with the current method and the new method. This comparison does not take into consideration how dirty the floor was before cleaning began.

- Cleanliness after cleaning in the **entrance hall** (solely machine cleaning with Twister™) was 38% better than with the current method. This difference is not significant because of the large variation in the cleanliness after cleaning with the current method (large confidence interval). Twister™ resulted in cleaner floors with less variability in the cleanliness. The bacteria levels are significantly lower with Twister™ than with the current method despite the fact that Twister™ uses water alone and the current method uses detergent with antibacterial properties.
- After **deep cleaning** with Twister™ the amount of particles on the floor increased significantly in the ward corridor. The increase was not significant in the ward room. Possibly these particles originate from the polish. The bacteria levels were much lower, namely 69% in the corridor and 100% in the room after deep cleaning with Twister™ compared to the current method. These reductions were significant.
- **Daily cleaning** with Twister and microfiber mop lead to considerably better cleanliness both in the corridor (55% fewer particles on the floor), where Twister was used one to two times per week and the floor was mopped on all other days, and in the room (47%, where the floor had been deep cleaned with Twister and was mopped daily. These results were significant. The evaluation also indicates that these cleaning methods result in considerably lower levels of bacteria on the floor, but the difference was not significant due to the very large variation in bacteria count, especially in the ward room after cleaning with the current method.

5.4 Particle levels in air

The study found that the number of particles of sizes > 1.0 μm and > 5.0 μm increased in the room cleaned with dry mopping, and also in the corridor which was cleaned twice a week with Twister™ and mopped with a dry mop on all other days. The increase in particle count in the corridor was marked; whilst in the room it was marginal.

The measurements that are shown in Appendix 3 show how particle levels vary through the day with the different cleaning methods. It is clear that higher particle levels occur mainly in the daytime and especially over the lunchtime period. It is very likely that these raised levels are due to more movement in the building, which causes the dust to be stirred up. Dry mopping can also cause higher dust levels.

From the measurements made in this study it is not possible to evaluate whether, or to what extent, the use of Twister™ contributes to the increased dust levels. Nor is it possible to evaluate whether there are other factors that may have contributed to the increase, for example, whether chemical residues on the floor trap the dust. In most applications Twister is used together with water, which can be assumed to trap most of the dust. There are elements of the deep cleaning process where Twister is used without water. In this case it is preferable that Twister is used with a cleaning machine that is equipped with an exhaust that effectively traps any dust that is generated and

ensures that the dust is not spread on the premises. A machine with such an exhaust was used during the study. However, the efficiency of the exhaust in trapping the dust that is generated can vary between models.

Although the dust levels in the corridor increased, cleaning with Twister implies cleaner floors than the current method in the long term.

5.5 Friction

The measurements show that in general, floor friction is lower after cleaning with Twister. This was found to be the case when Twister was used twice a week. It was also the case when the floor was cleaned with a dry mop for up to one month after deep cleaning with Twister, even if the significance level was low in both cases.

Mopping work involves load on the shoulders. This load depends on the weight of the mop, mopping technique and friction with the floor amongst other things. Cleaners often say that the floor is easier to clean and the workload is lighter when floor care has recently taken place. Floor care involves applying a surface film to the floor which reduces friction.

The results show that friction was reduced after deep cleaning with Twister, which is likely to reduce the load for the cleaner when mopping the floor.

The project plan also included measuring the cleaners' workload through measurements of pulse. It was however decided that these measurements would not be made because the cleaning area was so small that it would be difficult to attain reliable measurements.

6 Conclusions

The measurements show that:

Daily machine cleaning
Cleaning with the new chemical free method improved the cleanliness by 35 % and decreased the amount of bacteria by 61 % on average. The improvement is statistically significant.

Cleaning with the current method improved the cleanliness by 19 % and decreased the amount of bacteria by 29 % on average. This improvement was **not** statistically significant. It should be noted that three out of four measurements showed an increase in number of microorganisms after cleaning.

Conclusion: The new chemical free method with water and Twister™ resulted in better cleanliness and considerably fewer bacteria in daily machine cleaning than the current method where antibacterial detergents are used.

Machine cleaning 1-2 times per week and daily mopping
The new chemical free method resulted in a 21% improvement in cleanliness and 80% less bacteria after cleaning compared to before cleaning. These results were statistically significant.

The current cleaning method resulted in an improvement in cleanliness of 27% at the beginning of the measurement period (statistically significant). At the end of the cleaning period, the floor was found to be cleaner before cleaning than after cleaning with the current method but this result was not statistically significant. The amount of bacteria was on average 25% lower after cleaning but this result was not statistically significant. (Of the eight cleaning events studied, the amount of bacteria was lower after cleaning on two occasions, unchanged on three occasions and higher on three occasions.)

Conclusion: In a schedule consisting of machine cleaning 1-2 times per week and mopping on all other days, the new chemical free method resulted in considerably less bacteria than the current method. It is not possible to draw any conclusions regarding differences in the cleanliness resulting from the two methods.

Daily mopping
Neither the new nor the current cleaning method resulted in a change in cleanliness after daily mopping. The amount of bacteria was also unchanged for the new cleaning method. The amount of bacteria was at a low and stable level with the new cleaning method. However, the current cleaning method resulted in greater amounts of bacteria on five of the eight occasions studied.

Conclusion: Using the Twister™ to deep clean a floor appears to have long term effect on the amount of bacteria; the amount of bacteria remains on a steady, low level. This conclusion is based on relatively few measurements and should therefore be treated cautiously.

Dust levels
The number of particles of sizes > 1.0 μm and > 5.0 μm increased in the room cleaned with dry mopping, and also in the corridor which was cleaned twice a week with Twister™ and mopped with a dry mop on all other days. The increase in particle count in the corridor was marked; whilst in the room it was marginal.

Friction
The friction encountered when a mop is swept across the floor was measured. Floors that were cleaned with Twister™ had a uniform and low level of friction (0.4-1.1 N). Floors that were cleaned using the current method had greater friction (0.8-3.3 N). Lower friction is likely to result in lower load for cleaners if the floor is cleaned with a mop.

Deep cleaning
Deep cleaning is achieved considerably faster with Twister™ (1.3 minutes per $m^{2)}$ than with the current method of floor care (12.8 minutes per m^2).

Chemical usage
The use of chemicals is completely eliminated with Twister™. The current method uses 0.83 dl/m^2 during deep cleaning. No data are available on the amount of chemicals used in ordinary cleaning with the current method, but the reduction is likely to be considerable since this concerns daily cleaning.

In environments where many stains appear on the floor and where daily cleaning is mainly dry mopping, extra efforts are often needed and some form of wet treatment is necessary to remove the marks.

Appendix 1. Description of the current and new cleaning methods

Cleaning procedure, new cleaning method

The following cleaning procedure was used during the evaluation.

Ward 61

Corridor

Equipment: Cleaning machine equipped with a green Twister™ pad and a dry microfiber mop.
Routine: The floor was cleaned with a machine 1 or 2 times during the week. On all other days the floor was mopped with a dry microfiber mop.

The floor was ”deep cleaned” before beginning to use the new method.

Room 8

Equipment: Cleaning machine equipped with a green Twister™ pad and dry microfiber mop.
Routine: Manual cleaning with a dry microfiber mop.

The floor was ”deep cleaned” with Twister™ before beginning to use the new method.

Other rooms and areas on the ward

Routine: Manual cleaning with a dry microfiber mop.

2nd floor – Entrance for emergency cases

Equipment: Cleaning machine equipped with Twister™ pads.
Routine: Machine cleaning every day. No mopping.

Cleaning procedure, current cleaning method

The current cleaning method is described below:

Ward 61

Corridor

Equipment: The cleaning machine equipped with pads and mops that are usually used on the ward.
Routine: The floor was cleaned with a machine 1 or 2 times during the week. On all other days the floor was mopped with a damp mop microfiber mop usually used on the ward.

Room 8

Equipment: Mops usually used on the ward.
Routine: Manual cleaning with a damp mop.

Periodic floor care is performed up to one time per year.

2nd floor - Entrance for emergency cases

Equipment: The cleaning machine equipped with pads usually used.
Routine: Machine cleaning every day. No mopping.

Appendix 2. Detailed measurement results for cleanliness and microorganisms

All measurement results cleanliness and microorganisms in the entrance hall are shown below. The likelihood that the floor is cleaner after cleaning than before is calculated using the t-test.

Entrance hall, cleanliness

Cleanliness

1st measurement

	Current cleaning method		**Twister**™	
	Before cleaning	After cleaning	Before cleaning	After cleaning
	3.4	3.2	2.7	1.9
	5.5	4.1	2.7	1.0
	2.9	1.7	4.6	1.3
	1.0	1.6	1.3	2.4
	1.3	1.1	0.8	0.2
	2.9	0.7	1.5	0.4
	0.7	0.3	3.7	1.3
	3.0	4.3	1.9	1.3
Mean	**2.6±1.1**	**2.1±1.1**	**2.4±0.9**	**1.2±0.5**
T-test	0.28	0.72	0.04	0.96

2nd measurement

	Current cleaning method	**Twister**™	
		Before cleaning	After cleaning
	No current cleaning	4.1	3.1
		1.1	3.0
		2.3	3.3
		3.5	0.9
		2.7	1.5
		1.4	0.3
		5.1	3.0
		4.4	2.0
		2.5	0.6
		1.1	1.2
		0.8	3.4
		3.1	1.2
		1.0	0.4
		2.2	1.2
		2.7	2.4
		2.1	1.0
Mean		**2.5±0.6**	**1.8±0.5**
T-test		0.07	0.93

Amalgamation of all measurements

Current cleaning method		**Twister**™	
Before cleaning	After cleaning	Before cleaning	After cleaning
3.4	3.2	2.7	1.9
5.5	4.1	2.7	1.0
2.9	1.7	4.6	1.3
1.0	1.6	1.3	2.4

	Cleanliness				
	1.3	1.1		0.8	0.2
	2.9	0.7		1.5	0.4
	0.7	0.3		3.7	1.3
	3.0	4.3		1.9	1.3
	2.6±1.1	**2.1±1.1**		4.1	3.1
Mean	0.28	0.72		1.1	3.0
T-test				2.3	3.3
				3.5	0.9
				2.7	1.5
				1.4	0.3
				5.1	3.0
				4.4	2.0
				2.5	0.6
				1.1	1.2
				0.8	3.4
				3.1	1.2
				1.0	0.4
				2.2	1.2
				2.7	2.4
				2.1	1.0
			Mean	**2.5±0.5**	**1.6±0.4**
			T-test	0.01	0.99

Entrance hall, bacteria

Bacteria

	Current cleaning method			**Twister**™	
	Before cleaning	After cleaning		Before cleaning	After cleaning
	8	9		10	0.3
	4	9		3	0.2
	1	2		2	1.8
	22	4		4	0.1
Mean	**9±9.3**	**6±3.6**		**5±3.5**	**1±0.8**
T-test	0.65	0.35		0.12	0.88

	Current cleaning method		**Twister**™	
			Before cleaning	After cleaning
	No current cleaning		2	1
			2	1
			3	1
			3	1
			3	2
			5	6
		Mean	**3±1**	**2±2**
		T-test	0.08	0.92

	Current cleaning method			**Twister**™	
	Before cleaning	After cleaning		Before cleaning	After cleaning
	8	9		10	0.3
	4	9		3	0.2
	1	2		2	1.8
	22	4		4	0.1
Mean	**8.5±9.1**	**6.0±3.5**		2	1
T-test	0.65	0.35		2	1
				3	1
				3	1
				3	2
				5	6
			Mean	**3.8±1**	**1.4±2.3**
			T-test	0.04	0.96

Ward 61, cleanliness

Cleanliness

1st measurement, Ward 61

Current cleaning method				**Twister**™			
Room		**Corridor**		**Room**		**Corridor**	
Before cleaning	After cleaning	Before cleaning	After cleaning	Before cleaning	After cleaning	Before cleaning	After cleaning
3.5	2.2	3.5	3.5		6.7		6.1
2.5	2.6	6.2	4.3		3.1		3.0
		3.3	1.9		2.5		5.1
		2.1	1.2		2.6		4.6
		1.0	0.6		1.6		6.8

Cleanliness								
			2.1	2.8		1.2		4.5
			1.5	0.2		3.1		4.5
			1.0	0.7		1.1		1.6
						2.2		2.5
								1.0
								2.3
								3.3
								4.5
								3.1
								3.9
								3.0
Mean	**3.0±2.5**	**2.4±2.6**	**2.6±1.2**	**1.9±1**		**2.7±1.1**		**3.7±0.8**
T-test	0.55	0.45	0.06	0.94				

2nd measurement, Ward 61								
Current cleaning method					**Microfiber mop**		**Microfiber mop + Twister™**	
Room			**Corridor**		**Room**		**Corridor**	
Before cleaning		After cleaning	Before cleaning	After cleaning	Before cleaning	After cleaning	Before cleaning	After cleaning
	2.1	2.9	11.3	13.3	2.7	5.5	4.7	3.6
	5.8	2.1	9.9	9.9	1.3	0.6	6.9	5.5
	5.0	8.0	6.8	7.1			2.7	1.8
	5.9	8.5	6.7	5.5			2.9	1.9
			2.9	5.9			2.9	1.3
			2.3	4.6			1.6	2.5
			7	5.3			4.8	1.6
			0.4	3.3			4.3	4.8
			2.9	0.7			0.8	1.1
			3.5	7.7			2.4	2.0
			2.6	4.2			2.6	2.4
			3.5	0.0				
Mean	**4.7±1.7**	**5.4±3.3**	**5.0±1.9**	**5.6±2.1**	**2.0±1.4**	**3.1±4.8**	**3.3±1**	**2.6±0.9**
T-test	0.69	0.31	0.37	0.63	0.66	0.34	0.06	0.94

Amalgamation of all measurements								
Current cleaning method					**Microfiber mop**		**Microfiber mop + Twister™**	
Room			**Corridor**		**Room**		**Corridor**	
Before cleaning		After cleaning	Before cleaning	After cleaning	Before cleaning	After cleaning	Before cleaning	After cleaning
	3.5	2.2	3.5	3.5		6.7		6.1
	2.5	2.6	6.2	4.3		3.1		3.0
	2.1	2.9	3.3	1.9		2.5		5.1
	5.8	2.1	2.1	1.2		2.6		4.6
	5.0	8.0	1.0	0.6		1.6		6.8
	5.9	8.5	2.1	2.8		1.2		4.5
			1.5	0.2		3.1		4.5
			1.0	0.7		1.1		1.6
			11.3	13.3		2.2		2.5
			9.9	9.9	2.7	5.5		1.0
			6.8	7.1	1.3	0.6		2.3
			6.7	5.5				3.3
			2.9	5.9				4.5
			2.3	4.6				3.1
			7	5.3				3.9
			0.4	3.3				3.0
			2.9	0.7			4.7	3.6
			3.5	7.7			6.9	5.5

Cleanliness								
			2.6	4.2			2.7	1.8
			3.5	0.0			2.9	1.9
							2.9	1.3
							1.6	2.5
							4.8	1.6
							4.3	4.8
							0.8	1.1
							2.4	2.0
							2.6	2.4
Mean	**4.1±1.3**	**4.4±2.4**	**4.0±1.3**	**4.1±1.5**	**2.0±1.4**	**2.7±1.1**	**3.3±1**	**3.3±0.6**
T-test	0.82	0.18	0.81	0.19	0.66	0.34	0.06	0.94

Ward 61, bacteria/microorganisms

	Bacteria							
	Current cleaning method				Twister TM			
	Room		Corridor		Room		Corridor	
	Before cleaning	After cleaning	Before cleaning	After cleaning	Before cleaning	After cleaning	Before cleaning	After cleaning
	3	45	2	5		0		1
	3	45	2	2		0		1
	5	1	5	5		0		1
	5	45	5	1		0		1
Mean	**4±1**	**34±22**	**4±2**	**3±2**		**0±0**		**1±0**
T-test	0.08	0.92	0.87	0.13	0.01	0.99	0.06	0.94

	Current cleaning method				Microfiber mop		Microfiber mop + Twister™	
	Room		Corridor		Room		Corridor	
	Before cleaning	After cleaning	Before cleaning	After cleaning	Before cleaning	After cleaning	Before cleaning	After cleaning
	6	2	1	4	3	4	4	0
	2	7	2	4	1	1	3	1
	40	3	10	1	3	3	6	3
	6	45	3	3	1	1	5	1
Mean	**14±17**	**14±20**	**4±4**	**3±1**	**2±1**	**2±1**	**5±1**	**1±1**
T-test	0.96	0.04	0.74	0.26	0.39	0.61	0.01	0.99

	Current cleaning method				Microfiber mop		Microfiber mop + Twister™	
	Room		Corridor		Room		Corridor	
	Before cleaning	After cleaning	Before cleaning	After cleaning	Before cleaning	After cleaning	Before cleaning	After cleaning
	3	45	2	5		0		1
	3	45	2	2		0		1
	5	1	5	5		0		1
	5	45	5	1		0		1
	6	2	1	4	3	4	4	0
	2	7	2	4	1	1	3	1
	40	3	10	1	3	3	6	3
	6	45	3	3	1	1	5	1
Mean	**8.8±8.8**	**24±16**	**3.8±2**	**3.1±1.1**	**2.0±1.1**	**1.1±1.1**	**4.5±1.3**	**1.1±0.6**
T-test	0.19	0.81	0.68	0.32	0.39	0.61	0.01	0.99

Appendix 3. Particle measurements, different size fractions

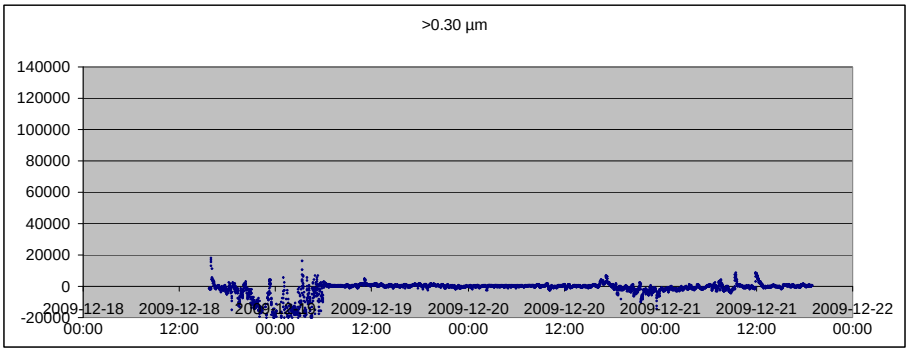

Figure 1. Particle count in air in a room with current cleaning methods. Size fraction >0.3 µm.

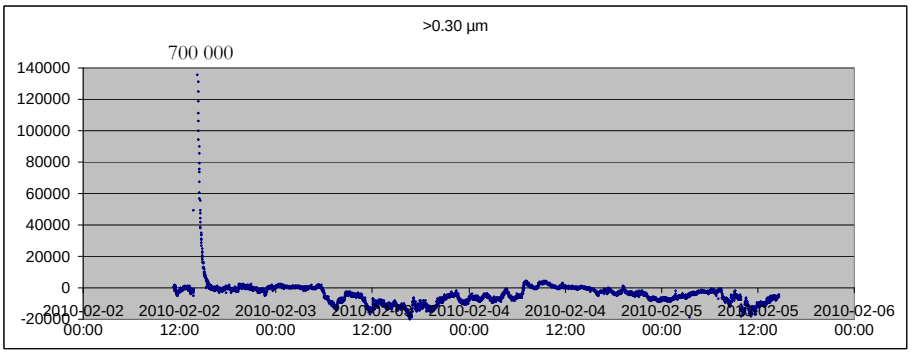

Figure 2. Particle count in air in a room cleaned with Twister™. Size fraction >0.3 µm.

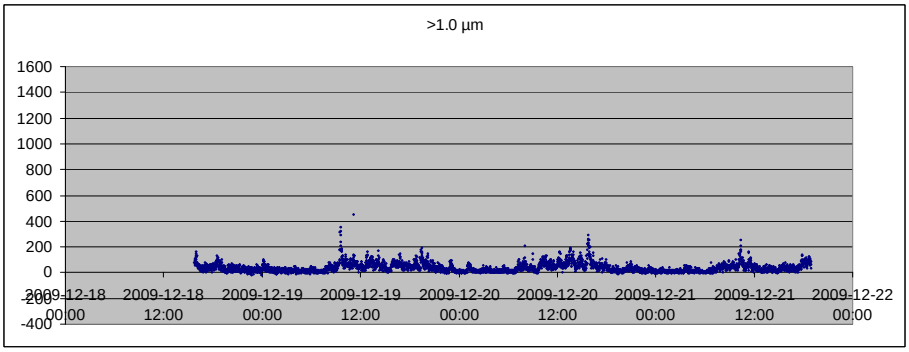

Figure 3. Particle count in air in a room with current cleaning methods. Size fraction >1.0 µm.

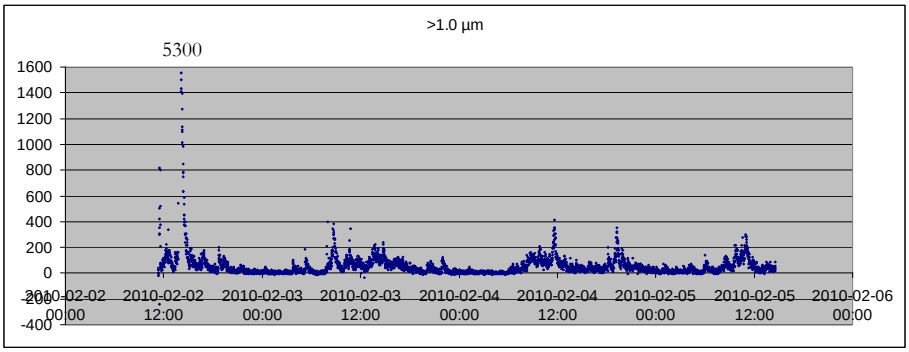

Figure 4. Particle count in air in a room cleaned with Twister™. Size fraction >1 µm.

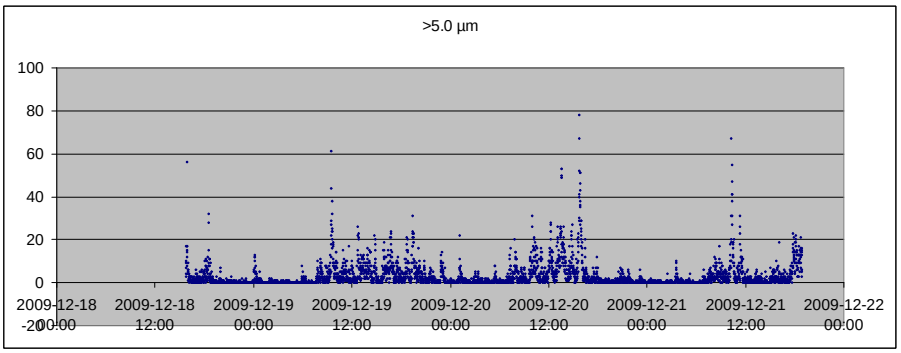

Figure 5. Particle count in air in a room with current cleaning methods. Size fraction >5 µm.

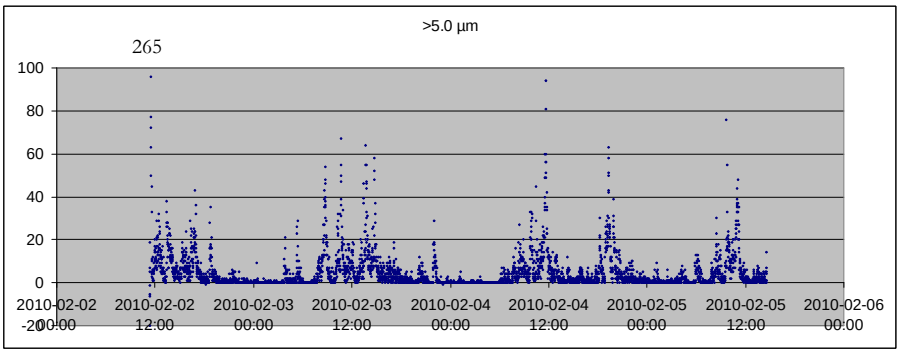

Figure 6. Particle count in air in a room cleaned with Twister™. Size fraction >5 µm.

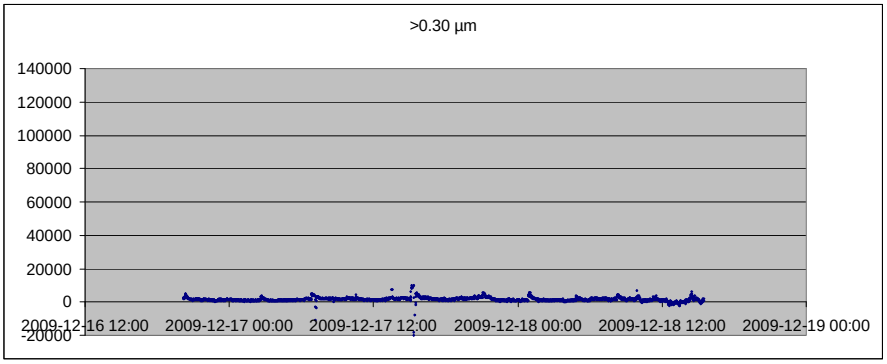

Figure 7. Particle count in air in a corridor with current cleaning methods. Size fraction >0.3 µm.

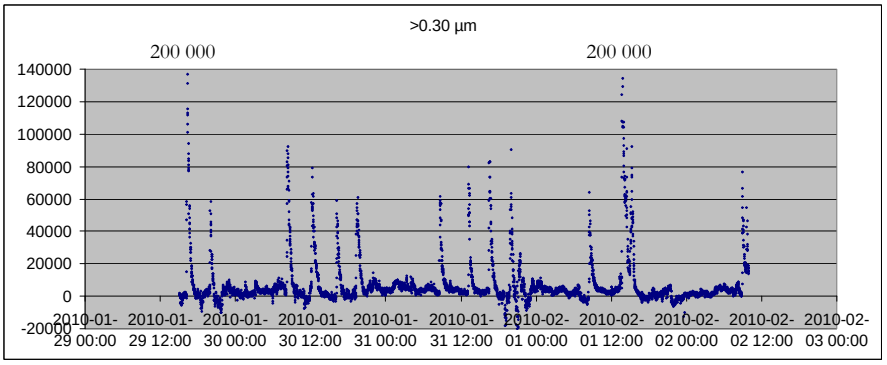

Figure 8. Particle count in air in a corridor cleaned with Twister™. Size fraction >0.3 µm.

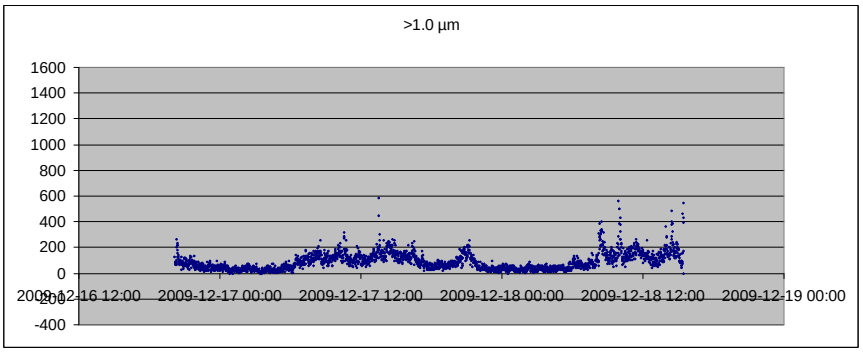

Figure 9. Particle count in air in a corridor with current cleaning methods. Size fraction >1 µm.

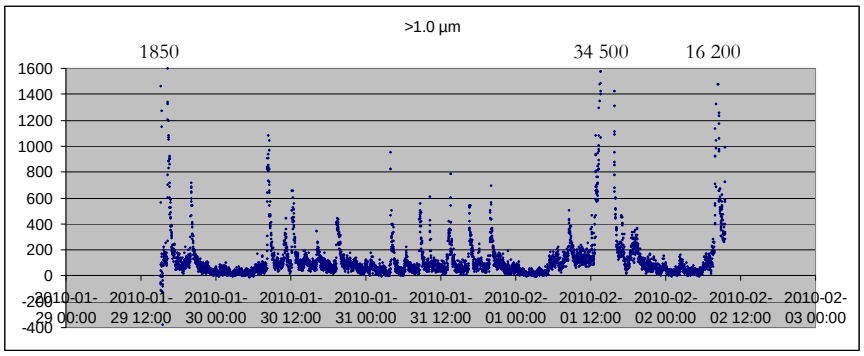

Figure 10. Particle count in air in a corridor cleaned with Twister™. Size fraction >1 µm.

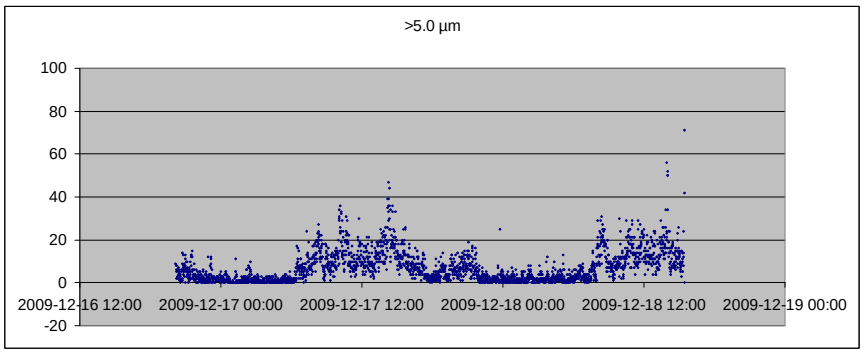

Figure 11. Particle count in air in a corridor with current cleaning methods. Size fraction >5 µm.

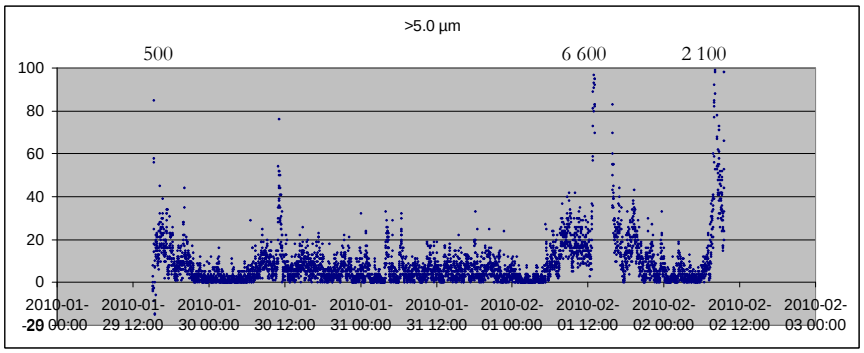

Figure 12. Particle count in air in a corridor cleaned with Twister™. Size fraction >5 µm.

Appendix 4. Evaluation of floor care with Twister™

Undertaken at Danderyd Hospital AB ward 63, room 8 start 11.36 2009-11-23

Summary:

Conditions:

Floor type:	linoleum
Surface area:	approx. 32 m^2
Coating:	old polish (several layers)
Condition:	commonly walked path is clearly visible, dirt around the edges and in the corners

Phases

Scraping with a spatula in the corners ***3min***
Gentle mechanical scrubbing of the floor ***16min*** (approx. 3 litres water)
Sucking up the water ***8min***
Machine polishing (high speed) ***15min***

Time taken: 42min
Chemicals: none

Floor care began: 11.36
Floor ready for use: Immediately (and even whilst work was underway)

Mechanical equipment: Floor machine with red Twister™ pad, 1 wet vacuum cleaner, and a polishing machine (High speed) with a green Twister™ pad
Other equipment:
1st spatula

Appendix 5 Evaluation of the current floor care method

Undertaken at Danderyd Hospital AB ward 61, room 610 (medicine room) start 12.10, 2009-10-13

Summary:

Conditions:

Floor type:	linoleum
Surface area:	approx 12 m^2
Coating:	old polish (several layers)
Condition:	commonly walked path is clearly visible, dirt around the edges and in the corners

Phases
Soaking of the floor ***5min*** (approx. 5 litre water + approx. ***2dl*** detergent, **Taski Jontec Tensol free SKU 7513142)**
Wait for the detergent to take effect. ***8min***

Manual scrubbing with brown scrubbing blocks around the edges, scraping with a spatula in the corners ***7min***
Gentle mechanical scrubbing of the floor ***12min*** (floor machine)
Sucking up the water and detergent (wet vacuum cleaner) ***4min***
Rinsing the floor, mopping with water ***3min***
Leave the floor to dry ***14min***
Application of polish (polish, Jontec Technique free SKU 7513199) ***3-4dl*** polish ***4min***
Leave the floor to dry ***20min***
Application of polish (polish, Jontec Technique free SKU 7513199) ***3-4dl*** polish ***4min***
Leave the floor to dry ***25min***
Addition application of polish where absorption was high (polish, Jontec Technique free SKU 7513199) ***1dl*** polish ***2min***
Leave the floor to dry ***25min***

Time taken: 133 mins = 2 hrs 13 mins
Chemical s: 10dl (based on 3-4dl per 3.5dl)

Floor care began 12.10
Floor ready to use 14.30

Mechanical equipment: Floor machine with brown pad (worn), 1 wet vacuum cleaner
Other equipment: 2 mop bases + 2st mop textiles, scrubbing block with handle, 1 bucket
1 spatula

Appendix 6. Methods

Cleanliness and bacteria/microorganisms on the floor

Measurement equipment

Cleanliness was measured through sampling with a tape, BM Dustlifter. The tape's absorbance is measured with a BM Dustdetector and the measurement result shows the proportion of the tape's surface area that is coated with dirt.

Bacteria were sampled with Hygicult TPC, a simple and fast method to measure the presence of bacteria/microorganisms. The result provides and approximate count interval for bacteria per unit of surface area.

Measurement strategy

Table 1 shows the number of samples that were taken on each measurement occasion and when they were taken. The tables show first the number of samples for cleanliness and then the number of samples for bacteria/microorganisms. The number of samples was increased during the study because the floor was found to emit fragments of polish which resulted in the rejection of some samples.

Table 1. Summary of the number of samples for cleanliness and bacteria in each measurement area and for each cleaning method. (Number of samples for cleanliness/bacteria)

Measurement point	Current method, 1st Dec 2009		Current method, 5th Jan 2010 (ward) 23rd Nov 2009 (entrance hall)		New method, 7th Jan 2010 (ward) 23rd Nov 2009 (entrance hall)		New method, 4th Feb 2010 (ward) 5th Jan 2010 (entrance hall)	
	Before cleaning	After cleaning	Before cleaning	After cleaning	Before cleaning	After cleaning	Before cleaning	After cleaning
Ward 61, corridor	10/4	10/4	16/4	16/4		16/4	16/4	16/4
Ward 61, room	10/4	10/4	16/4	16/4		16/4	16/4	16/4
Water in the cleaning machine						1		
Entrance hall, 2nd floor			8/4	8/4	8/4	8/4	16/8	16/8
Water in the cleaning machine				1		1		

On the ward, 200 samples of cleanliness and 56 samples of bacteria/microorganisms were made in total. In the entrance hall, 64 samples of cleanliness and 32 samples of bacteria were made. In total, 264 cleanliness samples and 88 bacteria samples were collected.

Measurement of particle levels in the air

Measurement equipment

Particle levels were measured with Grimm, a direct reading instrument for particles. On one measurement occasion, an analogous instrument, Royco, was used. The instrument measures the particle count in a number of different size intervals. The measurements are continuously registered, with many measurements per minute if so desired. In this study, one measurement per minute (mean value) was registered in a data logger. Two instruments were used simultaneously: one to measure the air in the room or corridor, and one to measure the intake air.

Measurement strategy

Measurements of particle count were taken on ward 61 in three locations: the corridor, room 8 and in the intake air. The measurement schedule is shown in Table 2.

Table 2. Overview of the measurements of particle levels taken on ward 61.

Cleaning method	Number of days measured	Date	Measurement points	Instrument
Current	3 + 3	End of Nov	Intake air Corridor Room 8	Royco Grimm Grimm
Current	3	The week before Christmas	Intake air Corridor	Grimm Grimm
Current	3	The week before Christmas	Intake air Room 8	Grimm Grimm
New cleaning method	3	End of Jan/start of Feb	Intake air Corridor	Grimm Grimm
New cleaning method	3	End of Jan/start of Feb	Intake air Room 8	Grimm Grimm

The measurement strategy has taken into consideration the following points:

- Measurements at the beginning and end of the test period. Evaluation of
  - how the cleaning method affects particle levels
  - how the particle level is effected by a period of cleaning with Twister™.
- Some of the airborne particles in the building are fed in through the ventilation system. For this reason, the particle levels in the intake air were also measured, in order to assess whether this affected the particle levels in the building. Measurements were made with the same type of instrument in all locations in order to be able to compare the levels.
- Particle levels are very dependent on the amount of movement in the building. Levels are therefore often higher during the daytime, when there is a lot of movement, compared to during the night. It is difficult to measure the amount of activity in the building and to assess the effects of the activity on the particle levels. In order to reduce the importance of temporarily high levels of activity, the measurements were made periods of several days at a time.

- The ventilation system is very significant for particle levels in the air. Since the measurements were made on a hospital ward, we assume that there were no changes made to the ventilation system during the measurement period. We have made contact with the manager responsible for the ventilation system at the hospital, to ascertain whether any irregularities took place during the measurement period.

Measurements of friction

Measurements of friction

The friction between the equipment and the floor during manual cleaning was measured. Measurements were made directly after cleaning with the current cleaning method and then about one month later after cleaning with the new method in the corridor of ward 61. The measurements were made with a dynamometer attached to a microfiber mop mounted on a mop foot without a handle attached. The dynamometer register the amount of force needed to set the mop in motion across the floor. Three measurements were made per cleaning method.

This evaluation method evaluates:
Cleaners often comment that the floor is easier to clean and the workload is lighter when floor care has recently taken place. Friction measurements are an objective measure of the friction between the mop and the floor. Measurement and comparison of friction between the different cleaning methods is a good way to verify the cleaners' subjective experiences.

Time taken for deep cleaning of the floor and floor care

The time taken for deep cleaning of the floor and for floor care with the different cleaning methods was studied. The work involved in deep cleaning with Twister™ and with floor care was documented and the time that this work takes was measured. The quantity of cleaning chemicals used was also measured.