

## **Cleaning of hospital floors with oiled mops**

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Large numbers of bacteria are dispersed into the air when untreated floors are swept with a broom. Contamination from this source has been controlled by treating floors with spindle oil (van den Ende, Lush & Edward, 1945), but the method has some drawbacks, in particular the damage that it causes to leather shoes. An effective alternative to oiling of floors which is free from these drawbacks is the use of vacuum cleaners with adequate filters (Rogers, 1951; Bate, 1961). Another method by which the dispersal of floor dust may be reduced is the use of impregnated mops (Burnham, 1962). We describe here a comparative study of floor cleaning in a hospital ward by mops impregnated with a mixture of oils, by a vacuum cleaner and by brooms; the methods were compared in respect of their removal of bacteria from the floor and the contamination of air during their use.

### MATERIALS AND METHODS

#### *Floor-cleaning equipment*

The special mops ('Kex') (see Pl. 1) had been treated with a mixture containing mineral and vegetable oils and other ingredients. It was claimed by the manufacturers that the mops would absorb dust and prevent its dispersal into the air. These properties would be retained on storage for about 2 weeks, after which it was recommended that the treatment with oils should be repeated; for this purpose a service of fortnightly collection and delivery had been established, ward mops being replaced from the hospital store every 2 or 3 days. During the experiments described here a supply of treated mops was delivered 2 or 3 days before they were used for sweeping a ward, and collected at the time of delivery of freshly treated mops for the next experiment. A special handle and frame for the mops was provided by the manufacturer.

The vacuum cleaner used in these studies was an 'Electrolux' Model 33, with an air filter attached to the outlet of the tank container.

#### *Sampling of floors for bacteria*

Impression plates were taken from selected areas of floor by a method described by Foster (1960). Strips of sterile bandage, 1½ in. wide, were laid across the bottom of sterile Petri dishes before a nutrient agar medium was poured into them. Samples were taken by removing the disk of medium, with the aid of forceps, by the projecting ends of the bandage; the outer surface of the Petri dish was applied over the medium, and with it the medium was pressed gently but firmly for

15 sec. over the selected area of floor. The agar disk was then transferred to the lid of the Petri dish, and incubated at 37° C. for 24 hr. In most of these experiments the medium used was phenolphthalein diphosphate agar (with 4% New Zealand agar), which allowed a presumptive count of *Staphylococcus aureus* as well as total viable counts (Barber & Kuper, 1951); in other experiments horse blood agar with 4% New Zealand agar was used. Surface viable counts were made with the aid of a hand lens.

#### *Air sampling for bacteria*

The air of the ward was tested with a large slit sampler, 11.5 cu.ft. of air being sampled on phenolphthalein diphosphate agar or horse blood agar.

#### *Comparison of three methods of floor cleaning*

Two open wards with wooden floors were used for the experiment. In one of the wards (I) the floor had not been treated with any oil for 6 months. In the other ward (II) the floor (2175 sq.ft.) had been treated 1 week before the first of three weekly experiments with 500 ml. of a mixture of linseed oil (1 part) and 'O'Cedar' oil (2 parts). The oil was applied with a polishing machine to improve the appearance of the floor, and was not expected to have any dust-laying properties; our tests confirmed this supposition.

In the first part of the experiment weekly tests were made in ward I; no beds were made during the hour before the test and while the test was in progress. Three tests were made with each of the three floor-cleaning methods, fresh oiled mops, vacuum cleaner and brooms; the three methods were used in rotation (i.e. a different method was used each week). Eight marked areas of floor in the middle of the ward were sampled before and immediately after the whole area of the floor had been cleaned. Air samples were taken before, during and immediately after cleaning. The time taken in cleaning the floor was noted.

In the second part of the experiment three further tests were made with each of the three cleaning methods. This time the oiled mops were tested when fresh and again 2 days later during their seventh use for cleaning the floor of ward I. Three further tests were made with a broom in ward II, and three further tests with the vacuum cleaner, two of them in ward I and one in ward II. Bacterial samples were taken as in the first part of the experiment.

## RESULTS

### *Floor sampling*

The bacterial counts of impression plates (mean of eight plates in each experiment) taken before and after floor cleaning are shown in Table 1. In each experiment the greatest reduction was found after the use of oiled mops; results were approximately the same with fresh oiled mops and with oiled mops used seven times. Bacterial counts were not reduced after the use of a broom. There was a significant difference in the mean percentages of initial counts in the comparison of the broom and the oiled mop ( $t = 4.67$ ,  $P < 0.001$ ), and in the comparison of

the broom and the vacuum cleaner ( $t = 3.33$ ,  $P < 0.01$ ). Presumptive counts of *Staph. aureus* (Table 3) showed a reduction after cleaning with the vacuum cleaner and the oiled mop, but a slight increase after the use of a broom; the numbers were small, and differences of means did not reach the level of statistical significance.

Table 1. Removal of bacteria from floor by alternative cleaning methods

Cleaning method	Exp.	Ward	Mean viable counts of floor samples		
			Before cleaning (initial count)	After cleaning	
				No.	% of initial count
Broom	1	I	1003	798	79.6
	2	I	773	579	74.9
	3	I	522	657	125.9
	4	II	524	547	104.4
	5	II	316	270	85.4
	6	II	456	448	98.2
	Mean	—	599.0	549.8	94.61 ± 7.7
Oiled mop (fresh)	1	I	387	119	30.7
	2	I	539	271	50.3
	3	I	864	300	34.7
	4	I	462	322	69.7
	5	I	394	224	56.8
	6	I	473	252	53.3
	Mean	—	519.8	248.0	49.3 ± 5.9
Oiled mop (used 7 times)	1	I	286	126	44.1
	2	I	303	163	53.8
	3	I	349	188	53.8
	Mean	—	312.6	159.0	50.5 ± 3.3
Vacuum cleaner	1	I	500	198	39.6
	2	I	547	287	52.5
	3	I	546	305	55.9
	4	I	669	486	72.6
	5	I	821	715	87.1
	6	II	848	464	54.7
	Mean	—	655.2	409.2	60.4 ± 6.8

#### Air sampling

The results of total counts are summarized in Table 2. They show a consistent rise (approximately a doubling) of airborne bacteria during the use of a broom, and a persistence of the raised air flora after the period of sweeping. By contrast, there was no increase (sometimes a fall) of airborne bacteria during the use of the vacuum cleaner, and after cleaning a consistent fall to a lower level than that found before cleaning. The oiled mop caused a small increase in airborne bacteria when used for the first time, but counts fell after cleaning to the numbers present at the beginning of the test. There was a significant difference in mean percentages of initial counts in the comparison of brooms with fresh oiled mops (during cleaning:  $t = 3.71$ ,  $P < 0.01$ ; after cleaning:  $t = 4.55$ ,  $P < 0.01$ ); also between the broom and the

vacuum cleaner (during cleaning:  $t = 6.80$ ,  $P < 0.001$ ; after cleaning:  $t = 8.82$ ,  $P < 0.001$ ) and between fresh oiled mops and vacuum cleaner (during cleaning:  $t = 2.51$ ,  $P < 0.05$ ; after cleaning:  $t = 3.71$ ,  $P < 0.01$ ). In the comparison of oiled mops used seven times with brooms there was no significant difference in tests made during cleaning, but the differences in counts obtained after cleaning were significant ( $t = 3.16$ ,  $P < 0.02$ ). When the mops had been used seven times they caused almost as much contamination of the air during sweeping as the broom, but these contaminants (unlike those dispersed by sweeping with a broom) fell rapidly from the air.

Table 2. *Contamination of air by alternative floor-cleaning methods*

Cleaning method	Exp.	Viable counts of bacteria per cu.ft. of air				
		Before cleaning (initial count)	During cleaning		After cleaning	
			No.	% of initial count	No.	% of initial count
Broom	1	124	270	217.7	270	217.7
	2	38	62	163.2	80	210.5
	3	67	134	200.0	124	185.1
	4	116	247	212.9	227	195.7
	5	82	168	204.9	190	231.7
	6	65	101	155.4	82	126.1
	Mean	82.0	163.7	192.3 ± 10.8	162.2	194.0 ± 15.2
Oiled mop (fresh)	1	51	49	96.1	51	100.0
	2	28	31	110.7	—	—
	3	143	169	118.2	103	72.0
	4	186	226	121.5	183	98.4
	5	68	131	192.6	107	157.3
	6	116	147	126.7	100	86.2
	Mean	98.7	125.5	127.6 ± 13.7	108.8	102.8 ± 14.5
Oiled mop (used 7 times)	1	137	243	177.4	152	110.9
	2	75	131	174.7	79	105.3
	3	48	105	218.7	69	143.7
	Mean	86.7	159.7	190.3 ± 14.3	100.0	120.0 ± 12.0
Vacuum cleaner	1	16	16	100.0	7	43.7
	2	237	293	123.6	149	62.9
	3	140	136	97.1	77	55.0
	4	76	40	52.6	38	50.0
	5	69	34	49.3	40	58.0
	6	85	58	68.2	14	16.5
	Mean	103.8	96.2	81.8 ± 12.1	54.2	47.7 ± 6.8

Although the differences in counts of presumptive staphylococci in the air did not reach the levels of statistical significance, they showed changes in relation to floor-cleaning methods similar to those shown by counts of total bacteria (see Table 3).

Table 3. Presumptive *Staphylococcus aureus* removed from floor and dispersed into air

Cleaning method	Mean viable counts per cu.ft. of air									
	Mean viable counts in floor samples					Mean viable counts per cu.ft. of air				
	No. of experiments	Before cleaning (initial count)	After cleaning	Mean % of initial count	Before cleaning (initial count)	No.	Mean % of initial count	No.	Mean % of initial count	
Broom	4	4.19	5.16	140.7	0.37	1.28	346.9	1.00	268.7	
Fresh oiled mop	4	7.10	4.39	70.7	0.50	0.80	203.3	0.783	145.1	
Oiled mop used 7 times	3	4.54	2.13	73.8	0.29	0.58	300.0	0.44	233.3	
Vacuum cleaner	4	5.78	3.25	67.7	0.35	0.24	116.7	0.41	112.5	

*Impressions of use*

The mean times taken in cleaning the ward by the three methods were as follows: oiled mops (two in use, one of 20 in. and one of 12 in.): 12.3 min. (s.e. = 1.0), vacuum cleaner: 37.8 min. (s.e. 3.0), brooms (two in use): 12.6 min. (s.e. = 1.4).

The broom caused an unpleasant cloud of dust in both wards. Airborne dust was not noticed when using the oiled mops or the vacuum cleaner. The floor surface of ward I, which was unoiled, acquired a pleasant slightly polished appearance after repeated use of the oiled mop.

## COMMENTS

In their removal of bacteria from the floor oiled mops compare favourably with the vacuum cleaner. The fresh oiled mop is also effective in reducing the dispersal of floor dust into the air, but although the results are sometimes as good as those obtained with a vacuum cleaner, they vary considerably. Oiled mops have certain advantages; they are quicker, quieter and easier to use than vacuum cleaners; in addition they give the floor a clean and lightly polished appearance. On repeated use they disperse large numbers of bacteria into the air; although these settle more quickly than the bacterial dust raised by a broom, it is probably desirable to cleanse and re-impregnate mops after a single use.

## SUMMARY

A comparison was made of three methods for the removal of dust from a hospital ward floor.

The viable bacterial counts of impression plates from the floor showed a mean reduction of 51 % after cleaning with fresh oiled mops, 40 % after cleaning with a tank model vacuum cleaner and 5 % after sweeping with a broom.

The mean proportions of airborne bacteria, compared with viable counts before cleaning, were 192 % during and 194 % after cleaning with a broom; 128 % during and 103 % after cleaning with an oiled mop, and 82 % during and 48 % after cleaning with a vacuum cleaner. On repeated use the oiled mop dispersed almost as much dust as a broom, but this settled rapidly from the air.

The effects of these cleaning methods on counts of presumptive *Staph. aureus* on the floor and in the air were similar to those found in counts of total organisms.

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EXPLANATION OF PLATE

An oiled mop (20 in.) in use on a ward floor.