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Utilisation of Scrubbing Machines for Hospital Cleanliness in Tertiary Care Medical Institute of North India

Ranjana Singh, A K Gupta, Ashok Kumar, Arun K Aggarwal

[1] Senior Resident, Dept. of Hospital Administration, PGIMER,Chandigarh, India; [2] Professor, Medical Superintendent- cum- Head, Dept. of Hospital Administration, PGIMER,Chandigarh, India; [3]Assistant Professor, Dept. of Hospital Administration, PGIMER,Chandigarh, India; [4] Professor, School of Public Health, PGIMER, Chandigarh, India
Email: aggak63@gmail.com

ABSTRACT

Hospital cleanliness is very important for any hospital. Whereas, developed countries use automated cleaning equipments, but resource constraint countries struggle to decide whether investment in the automated equipment for cleaning for example scrubbing machines, is worth? This observational and record review study was done to study the impact of automated scrubbing machines on the hospital floor cleanliness and to assess the utilization, maintenance and operational problems of these scrubbing machines. A cross-sectional study of eight automated scrubbing machines was carried out in 979 bedded tertiary care hospital. The machine utilization, breakdown indices were recorded by logbook analysis and observation of floor cleanliness was done using pretested score sheet. Health care providers and the patients were interviewed to assess their perceptions about hospital cleanliness.

The overall Utilisation Coefficient (UC) of all the scrubbing machines was 64%. The UC of big Scrubber machines (meant for corridors) was 68%. The UC of small scrubbing machines ranged from 53% to 68% with no downtime. During pre-cleaning observation, 58% (14/24) of the observed hospital areas had cleanliness score less than 50% of the achievable score. However during post cleaning, all the wards scored more than 74% of the achievable score. Minimum score achieved got increased from 14 in the pre-cleaning phase to 37 in post-cleaning. Thus, use of automated cleaning equipments in public sector hospitals in developing countries can boost cleanliness with efficiency.

Keywords: Hospital cleanliness, Scrubbing Machine, Hospital Sanitation, Hospital Quality, Hospital Floor, Hospital Housekeeping

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1. INTRODUCTION

Hospital cleanliness provides visible and tangible signal to the patients about the quality of the clinical care they may experience. It is frequently used as a barometer to judge the overall quality of health care [1]. Patients have a right to expect a clean, tidy and well-maintained hospital environment and they do consider hospital cleanliness as an important factor when choosing a hospital [2].

Hospitals differ a lot in terms of the cleaning procedures performed. It range from use of traditional devices like buckets and mops to the modern products like floor machines and auto scrubbers. Although hospitals strive for cutting edge technology for medical care, but for cleanliness most hospitals and nursing homes still function with faulty methods. Hospital in the 21st century thus deserves further investigation for cleaning practices [3].

The mechanised cleaning equipments are costly compared to the traditional cleaning devices and also require regular specialized maintenance and repair, which can be very expensive. Hence there is often resistance in the organizations to invest on these items. Hospitals keep on using substandard methods of cleaning [4]. The scientific evidence to support cleaning practices is also not robust [5]. There is overall reluctance in the public organisations for mechanized cleaning due to apprehensions of underutilization and high downtime [6]. Proper planning and scheduling has the potential to maximize the utilization of the equipment and minimize the downtime [7]. However there are no experiences in published literature about the utilization of cleaning machines.

We therefore conducted this study to develop and test the methodology to evaluate the efficacy of the scrubber machines in terms of utilization and downtime indices and also assess its impact on hospital cleanliness.

2. METHODOLOGY

2.1 Study area and Equipments

This study was carried out at a 979 bedded hospital. The hospital had purchased 2 scrubbers cum dryer machines, hereinafter called as 'corridor machines', and 6 sets of scrubbing machines, hereinafter called as 'ward machines' with wet and dry vacuum cleaners. Sanitation department of the institute was running these machines in the hospital as per the preset schedule and on special requests from some areas if required. The two corridor machines were being operated 6 days/ week (except Sunday), in three shifts of 8 hours each viz. morning (6AM-2PM), evening (2PM-10PM) and night (10PM-6AM), to clean the corridors. Six ward machines with wet vacuum cleaners were operated 7 days/week, in one shift of 8 hours (10AM-6PM), and were used to clean the wards. For the purpose of study the machines were numbered from 1 to 8 (i.e. M1 –M8).

2.2 Study Design

Mixed design methodology was adopted. It was a cross-sectional study for interview of the scrubbing machine operators, the sister-in-charge of wards and the patient attendants. Prospective study design was followed for machine utilization assessment and calculation of breakdown indices.

2.3 Study Tools

Tools to assess the machine utilization, record maintenance and operational problems and to assess the impact of machine use on the cleanliness were developed and pretested. Tools had questions to record number of hours each machine was scheduled, number of hours it was used, and number of hours it was not used due to breakdown. Form was designed to record week wise information for the study months. There were questions related to the operational and maintenance problems, and knowledge of the operators about use of the machine, their perception about the efficacy of the machine for cleaning and their suggestions for improvements.

A questionnaire was designed to take the feedback from the sister-in-charge of the wards regarding use of scrubbing machine, their perception about efficacy of the scrubbing machines, frequency of cleaning with the machine in their area, the problems they faced with the use of the machine and any suggestions they may have for the improvement. Questionnaire was also designed to take feedback from the patients/ relatives regarding their assessment of cleanliness level in the hospital/ ward, both before and after cleaning with the machines.

Observation checklist was designed to record the pre-cleaning and post-cleaning observations, in each of the study areas, on a five point Likert scale with score 1= Very poor and 5= Very good.

2.4 Tool Administration

Operational schedule of the scrubbing machines was obtained from the sanitation department. These areas were visited without any prior information to the operators. Information from the machine logbook was retrieved. Each of the two corridor machines were observed five times in each of the three shifts for 4 months. Thus a total of 120 machine observations were done over a period of 4 months. Timing of the observations was spaced to ensure that machine is observed at the start of duty, at the end of duty and in the middle. Each time, observation was done for 2 hours duration. The schedule of observation was prepared every month in advance and was kept confidential. For five ward scrubbing machines, total of 10 observations were done per machine per month. Thus a total of 200 machine observations were done over a period of 4 months.

Interview of the all the 20 machine operators was done to assess maintenance and operational problems of the machine. All 40 Sister Incharge/Asst. Nursing superintendent (ANS) concerned with the ward/ area were interviewed to assess their views on the efficacy of scrubbing machines to cleanl the areas. A questionnaire for the patient or the relative of the patient admitted was prepared to assess their level of satisfaction. The questionnaire was put to the patient / relative in each ward cubicle just after the scrubbing was done in that area. For this purpose the patient/ relative was chosen randomly for the interview

2.5 Data Analysis

Following formulae were used for calculation of the operational indices:

1. Use coefficient= Nx100/M,
   (Where, N = Average number of hours the equipment is used per day, M = Maximum number of hours the equip-

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ment is to be used per day according to the schedule)

2. Down time index = Down time in hours / service time in hours x 100,
   This is the period of time during which equipment is not in a condition to perform the intended functions due to breakdown. It is a summation of problem realization time by the technician, diagnosis time by the service engineer, spare parts procurement time by the service agent and alignment time of spare parts in any equipment.
3. For assessing hospital cleanliness, total score of all the observations in each area were calculated for both the pre-cleaning and post-cleaning category. Percent (%) change in the cleanliness was then calculated and was tested for statistical significance.

3. FINDINGS

3.1Cleanliness Scores and Perceptions of Hospital Staff and Patients regarding Hospital Cleanliness

The cleanliness of each ward was assessed using the likert scale. The maximum achievable score was 50 both at the pre-cleaning and post-cleaning. The mean score obtained for the pre-cleaning was 22.96(95% CI: 20.82-24.35), and that for post-cleaning was 40.31(95%CI: 39.9-41.24). Increase in the mean score of cleaning status was significant ($p<0.001$).

During pre-cleaning, for 58% observations (14/24), score was less than 50% of the achievable score. However during post-cleaning, for all the ward observations, score of more than 74% of the achievable score was achieved. Minimum score obtained increased from 14 during pre-cleaning to 37 in post-cleaning.

The change in the pre and post-cleaning scores of the individual wards was also assessed. Maximum change in the pre & post cleaning score was observed in one of the general ward, which was 200%. The minimum change was obtained in a Private Ward which was 46%. Out of the 39 ward in-charges, 21(53.8%), felt that the cleaning by scrubber machine is good and 16 (41%), and felt that the cleaning is satisfactory. The salient conclusions were that cleaning has been good and it has enhanced the cleanliness standards in the hospital in general. It is better than manual cleaning.

All the patients/ attendants interviewed had seen the machines running in their ward. 81(50.6%) respondents felt that that the ward cleanliness was very good and another 66 (41.2%) felt that it was good. Pre-cleaning and post-cleaning responses indicated significant shift in the level of cleanliness from grade 2 to grade 3 &4.

3.2 Utilization Coefficients

During the four months study period, as per the log book, the overall Use Coefficient (UC) of all scrubbing machines (M1-M7) was 64.59%. The UC of corridor machines (M1&M2) was 68.93% and that of the ward machines (M3-M7) was 60.25%.

There was significant difference in the UC of two corridor machines (M1&M2). UC of machine M1 was 82.84%, and that for machine M2 was 55.02%. The machine M1 could not be used for 17.16% of the total scheduled time due to downtime, in the month of January due to wheel problem. The Downtime in the M2 machine was observed in all the four months with maximum in the month of January. This was also due to wheel problem as well as due to the non-functioning motor. The UC of ward scrubbing machine (M3-M7) ranged from 53% to 68% with no downtime. (Table 1)

3.3 Reasons for the high downtime of the corridor scrubber machine

The two most important reasons for the high downtime of corridor machines were the breaking of machine wheels and the non-functioning of the motor. One possible reason for the breakdown of motor was excess filling of the water tank with soap and water leading to excess froth reaching the motor. Damage to wheels occurred possibly due to 24 hour use of the machines, jerks in the vertical lifts during transportation, and lack of ball bearings in the wheels. Delay in addressing the problems occurred due to delays on the part of the vendor due to non-availability of spare parts, and due to lack of rate contract for the spare parts leading to administrative delays in processing the cases. Most of the non-utilization of the ward machines was due to the non–scheduling of all the machines in the given shift. The machines were scheduled on rotational basis

4. DISCUSSION

This prospective observational study has demonstrated that the scrubbing machines were effective in the hospital for floor cleaning. Visual observations of cleanliness were substantiated with the perceptions of nursing staff, patients and attendants. Overall utilization coefficient in this busy public sector tertiary care hospital with all constraints of manpower, materials and the delays for addressing the breakdown was around 65%, which seems reasonably well. There is no comparative study available to comment on the utilization relative to the other studies.

This study has provided an important benchmark for continuing quality improvement of cleanliness in the hospital. Study has given some important insights. We observed that the impact on cleanliness was significantly higher in one ward compared to the other wards. These variations may be due to different types of flooring in the wards, different patient load in and also socio-economic differential existing across these wards. Each private ward accommodates a maximum of 20 patients and general ward accommodates a maximum of 60 to 70 patients at a given point of time. Furthermore, in the general wards, patient's attendants use floor to sit, sleep and eat. Thus floors get dirty soon and are difficult to clean through routine manual cleaning. Thus, pre-post difference in such wards was probably much greater than the other wards. Nonethleess, there was substantial improvement in cleanliness of all the wards with the use of scrubbing machines. These differentials can guide hospital administrators for better planning of the scrubbing machines.

Important differentials were also observed in the utilization of different scrubbing machines and common reasons of non-utilisation. While purchasing and operating the machines due attention be given not only to the robustness of wheels and its maintenance but also to ensure that enough power sockets are available at convenient distances to operate the machines with short wires, that has emerged as an important bottleneck.

For better utilization, all the machines could have been used daily. However, one may argue that hospitals can keep couple of machines as back up, if other machines can clean the hospital at defined periodicity. It ensures that pre-defined schedule is not disrupted due to the breakdowns. Such breakdown indices are not available for the clean-

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ing equipment. However, interpretations can be derived from other hospital equipment breakdowns. In a study, 14% of all equipment were found in out of order state at a given point of time [8].

This study has much strengths. Firstly, to our knowledge this is the first study to document the utilization of scrubbing machines in the hospital and assess its impact on the cleanliness. Given the methodological difficulties in measuring the level of cleanliness on visual inspection, one can argue that the change in cleanliness as observed in the study may not reflect the true picture. However, there was no observer bias, as single observer made the observations, and she was well trained in the process. Furthermore, objective criteria's were laid down to measure the cleanliness and Likert scoring system was used for the same. Visual inspection may not have robust correlation with microbiological assessments or bioluminescence methods. But this is the only method that can be used for routine cleanliness assessments, Secondly, we followed mixed method approach for impact assessment. Thus observation findings were validated by perception of the ward sisters and the patients/ attendants regarding machine utilization and cleanliness. Thirdly, study observations were widely spaced in terms of time that avoided biases that could have occurred if observations were done at peak or least efficiency hours. Fourthly, study has brought out the issues of keeping some equipment as backup instead of enhancing the utilization by planning 100% time of all the machines. Last but not the least, study has also brought out the importance of seemingly trivial issues of providing electrical sockets at convenient distances, and having rate contracts for the spare parts.

Major limitation of the study was that no validated tools were available for observation measurements and interviews. We developed the tools, and validated the tools by consulting local experts in the field including the members of the institute thesis protocol review board. Tools were also pretested before final use. However, tools may be used in different settings and should be validated further before further use.

Another limitation is that the study did not make any comparison from the traditional bucket and mop cleaning system, which is still operational in routine. Scrubbing machines seemed to be much better in terms of manpower requirements, time required for cleaning per unit area and the quality of cleaning including odour control. Qualitative information provided by the sanitation staff and ward sisters did pointed towards these issues. In our hospital wet mopping is carried out thrice a day with detergents in each shift of the sanitation attendant. Spillage and isolation rooms with immune-compromised or HIV patients are cleaned with the wet mop. If more spillage is noticed then a disinfectant is poured on it and then wiped with a wet mop. The mop is then wringed dry after rinsing in water and stored. These problems are quite troublesome for the hospital staff and also expose them to high risk of contracting infections while cleaning the infected or isolation rooms/ wards. These inconveniences were easily overcome by switching over to the machine scrubbing system and are welcome from all the employees of the sanitation department of our hospital. In a well-designed study by Maurer et al it was found that most hospitals used a mop repeatedly to clean various rooms. While the liquid solution is changed, one mop is used for days together, without being cleaned. While only 70 per cent of hospitals use chemicals to clean floor and the rest used detergents. A neglected dry mop redistributes microbes, which have been picked up and can grow pseudomonas on it, which will get distributed again the next time while cleaning. The authors revealed that when both cotton and plastic mops were cleaned with water, the mops were heavily loaded with microbes when allowed to dry overnight. Scrubbing machines with inbuilt or separate vacuum systems are likely to be free from such microbial contaminations.

TABLE 1

USE COEFFICIENTS AND DOWNTIME INDICES OF SCRUBBER MACHINES OVER THE FOUR MONTHS OBSERVATION PERIOD.

Scrubber Machine	Utilisation coefficient	Downtime index
Corridor Machine M1	82.84%	17.16%
Corridor Machine M2	55.02%	44.98%
SUBTOTAL	68.93%	31.07%
Ward Machine M3	62.5%	0
Ward Machine M4	68.33%	0
Ward Machine M5	52.95%	0
Ward Machine M6	61.66%	0
Ward Machine M7	55.83%	0
SUBTOTAL	60.25%	0
TOTAL	64.59%	31.07%

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