ASSESSMENT OF CLINICAL DENTAL EQUIPMENT UTILIZATION AND INFLUENCING ATTRIBUTES

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ABSTRACT

Introduction: Accurate patient diagnosis is utmost important and foremost step for the proper clinical treatment; hence the role of diagnostic equipment is pivotal. However, improper maintenance and lack of skilled workforce and trained technicians are major cause for improper use and equipment failure in Indian scenario.

Materials and methods: An analytical and observational study was conducted in the dental department, in 2020 to evaluate the use coefficient (UC) of 7clinical dental equipment. While conducting the study the factors affecting the application of equipment also studied.

Results: On examination it was noticed, the use of equipment was 42%. The 04 equipment were not used sufficiently among the studied 07, and only 03equipment were used as per routine. Dental chair was utilized maximally with an average of 79% and UC of 82%, followed by IOPA machines with UC of 65% and ultrasonic scalars with UC 55%. Whereas, the least used equipment include Dental microscope and Vista Scan mini with UC 10% and 8% respectively. The result has been statistically significant between training, skill, and utilization.

Conclusion: maximum utilisation of equipment will promote return in investments. As a cost of medical treatment is certainly high, trained technicians and assistance will enhance the outcome of the equipment, hence the quality of treatment.

INTRODUCTION

The provision of high-end equipment and treatment has become competitive requirement and concern for the service providers. Today many health institutions have procured high end equipment for customer satisfaction and pool. But the utilisation of this equipment is not well aimed. Lack of management of clinical dental equipment has limited the scope of diagnosis and treatment. The availability and utilization of various health care equipment at all levels of the health care system has been emphasized for effective and efficient service delivery (2).

Both Developed and developing nations are struggling with skilled workforce to deliver the potential effect of equipment. Inadequate infrastructure and Equipment within the health care institutions will impact the effectiveness of healthcare delivery. They have a crucial role in providing efficient either diagnosis or treatment and therapeutic tools. It aids in healthcare profession and reduces the treatment time and hence increasing the efficiency (7). In the country like India, lack of trained technicians and skilled manpower, lack of preventive maintenance, absence of government training and screening programs, non-availability of infrastructure, limits the maintenance and utilization of equipment. Patient handling and turnover can be optimized, with the lowest feasible cost, high-quality patient care, and patient satisfaction due to appropriate equipment usage (11).

Use Coefficient= (M/N) x 100, Where N = Average number of hours the equipment is used per day. M is the average hours in day equipment should be used (4). If the UC of the equipment is greater than 50%, it is considered an adequate investment and cost-effective in the healthcare setting (7). The term "equipment utilization" refers to using the equipment to its greatest capability. It should be the responsibility of management to maximize the use of equipment to maximize the return on investment by providing training to the staff and professionals.

AIM AND OBJECTIVES

1. To observe the utilization of equipment
2. To evaluate the use coefficient (UC) of equipment used in the dental department of the public hospital in Sunder Nagar.
3. To identify the factors influencing the utilization of the equipment through the medium of standardized questionnaire.

MATERIALS AND METHODS

The study was designed in two phases. The first phase was Descriptive analysis, where the UC of the clinical dental equipment was calculated, and the second phase was analytical, where the factors influencing the UC was analyzed. The study was conducted in the public healthcare center, India. Study population were the professionals (dentist) and technical or assisting person who are operating, handling, and maintaining this clinical dental equipment. Data was collected using a self-administered, pre-tested, and structured Questionnaire. It was a modified questionnaire that had been validated by professionals and was based on earlier research. The questionnaire was prepared in English and Hindi. The questionnaire was divided into six sections, includes Human Factor, Equipment Factors, Management Factor and Environmental Factor.

Inclusion Criteria

Commonly used clinical dental equipment in the dental department was included.

Exclusion Criteria:

Medical equipment used elsewhere other than dental department in the hospital, for example, in Intensive care units, as per the WHO definition of medical devices the Implantable, disposable, or single-use medical devices were not considered in the study.

RESULTS

The data collected by analysing seven clinical dental equipment in the public health facility in India, which are: -

1. Dental chair
2. Endomotors
3. Ultrasonic scalars
4. IOPA machines
5. Physio dispenser
6. Dental Microscopes
7. Dental Scan

The results are calculated and statistically evaluated using SPSS. Descriptive statistics were used in this study to calculate various variables. The findings of this study are organized under the headings below:

1. No of average hours the equipment was used
2. Calculating Use coefficient of the equipment
3. Analysing effective utilisation of equipment
4. Association of equipment utilization with following factors
   - Human Factors
   - Equipment factors including technical factors
   - Management factors
   - Environmental factors

Time Duration for Utilisation of Dental Clinical Equipment

The average number of hours the equipment used was 2 hours. The dental chair was used for the maximum number of hours that is 6 hours. This was followed by the IOPA Machines (X-mind), which was used for 4 hours. Ultrasonic scalar and endomotor was used for approximately 3 hours and 2 hrs respectively. Implant Physio dispenser were used for average 1hr. The least used equipment was the dental microscope and Dental Scan which were used for 0.2 hours and 0.3 hours. The number of hours the equipment should be used was 7 hours on routine working days from Monday to Saturday with 8 hours working.
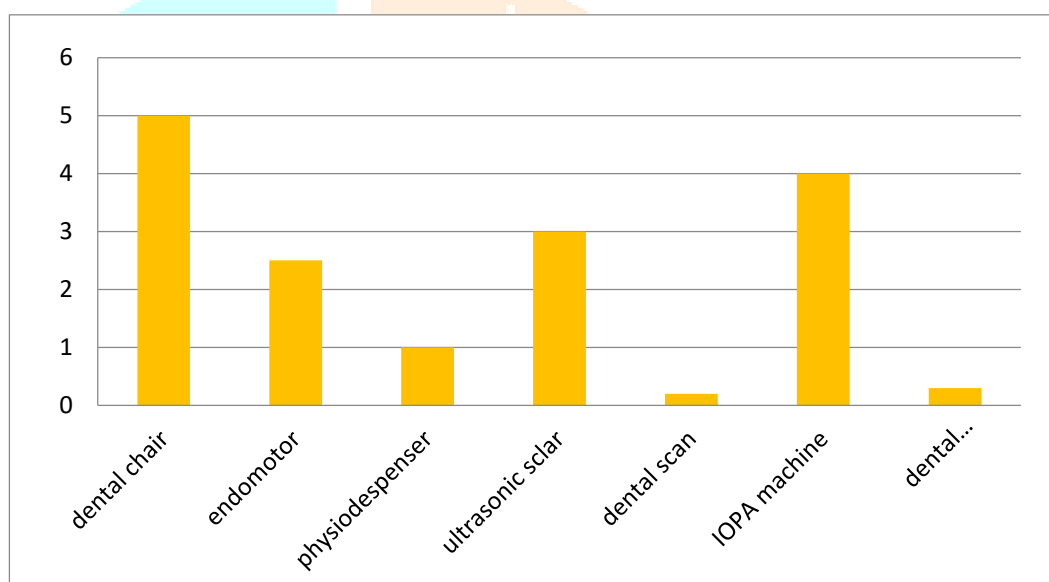

figure 1: time duration for utilisation of dental clinical equipment

Outcome of Use Coefficient of Equipment

The actual number of hours for which equipment is used, the maximum number of hours for which equipment can be used, and this UC is calculated for each piece of equipment. The use coefficient for the dental chair was the highest, which came out to be 75%. The IOPA machine (x mind) followed this with UC 55% and ultrasonic scalar with 50% UC. The use coefficient of the endomotor was 31%, and dental microscope is 3%, the least is for dental scan i.e., UC of 2%.
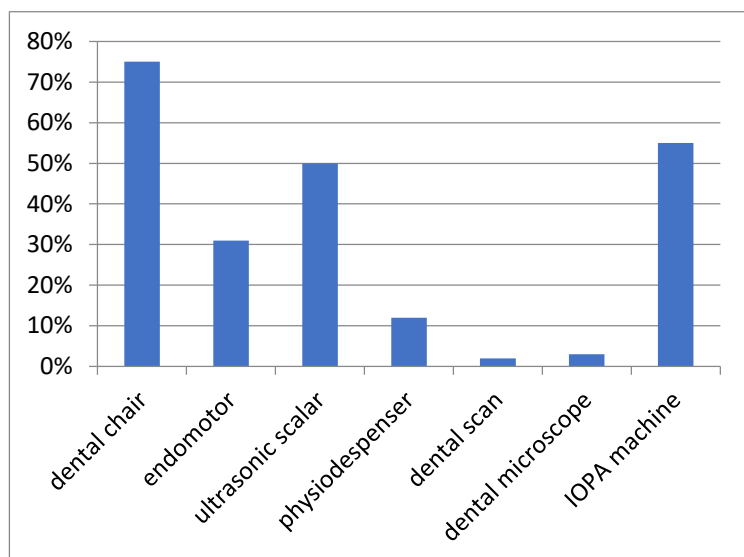
Figure 2: outcome of use coefficient of equipment

Analysis of effective utilisation of equipment

Out of 7 equipment, only 3 were optimally utilized due to the use coefficient of more than 50%, and this equipment was the Dental chair, IOPA machine and ultrasonic scalars. None of the equipment was over utilized, that is, use coefficient above 100%. Only 42% of the dental department equipment was optimally used, whereas 58% were underutilized. The table has depicted the ranking of these equipment based on their utilization.

table 1: use coefficient of the observed equipment and their ranking

S .no	Name of the equipment	Ranking of the equipment utilized	UC of equipment (%)
	Dental Chair	1	75
	IOPA machine	2	55
	Ultrasonic Scalars	3	50
	Endomotors	5	31
	Physiodespenser	6	12
	Dental Microscope	8	3
	Vista Scan Mini	9	2

Human factor

Handling capacity of equipment by dentists or technicians highly depends on skills pertaining to its use. Questionnaire prepared was analysed for results and it reveals 18 (76%) of the participants believed that the healthcare professional's skills in handling the equipment affect the utilization. Out of 24 participants, 2 (8%) respondents Disagree and 4(16%) participants were neither agree nor disagree. Training to use equipment properly is subsequent factor to enhance its efficiency. Provision of training to the handling staff is important and 22(92%) of the participants believed that the healthcare professional's skills in handling the equipment affect the utilization. Out of 24 participants, 1 (4%) were Disagree. Whereas, neither agree nor disagree were 1 (4%)
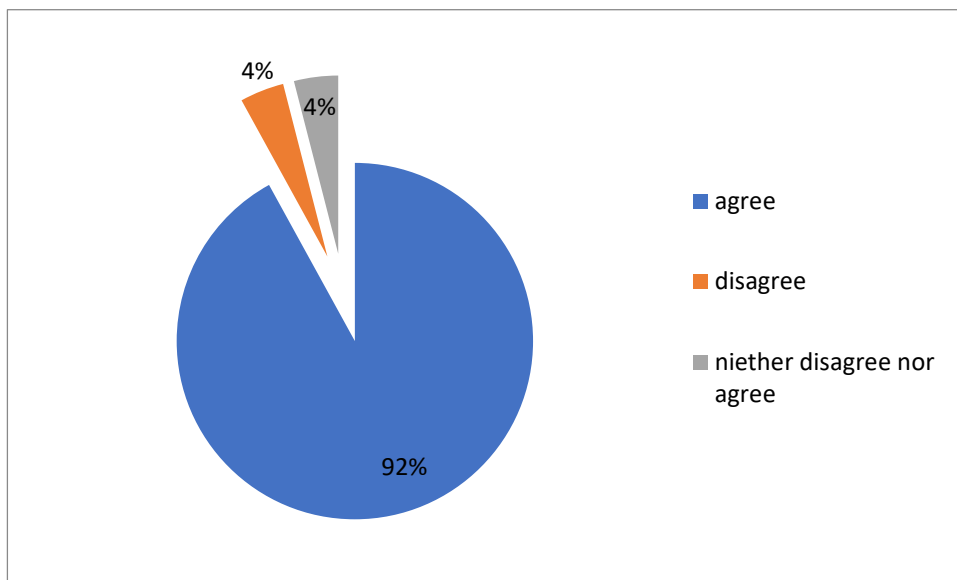
figure 3: provision of training to the staff

Equipment Factors

Equipment factors are the foremost area of concern as it requires regular maintenance and inspection for its efficiency. The absence of which can lead to unexpected downtime and failure affecting the utilization of the equipment. The effect of breakdown, failures and downtime affected the potency of equipment, 22(92%), believed that Failures, Downtime, and Breakdowns Affects the Daily Utilization of the equipment. In contrast, only 2 (8%) replied that it does not affect the use of the equipment in their department. This was in relation to the results seen with the maintenance only 3(12%) respondents reported that the equipment in their department is timely maintained whereas 21 (87%) professionals believed that the equipment lacks maintenance that effects the utilization.
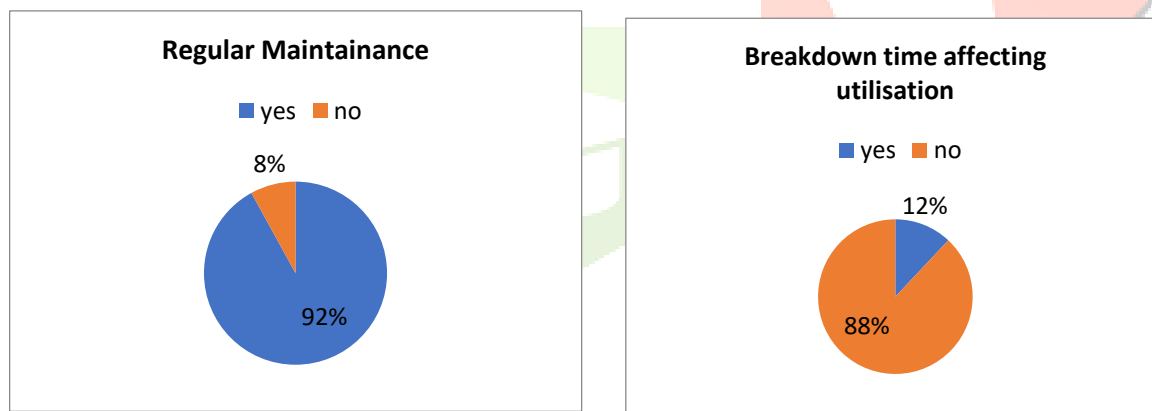

figure 4: regular equipment maintenance

Out of the 24 healthcare professionals working in the dental departments, only 1(4%) believed that the most common cause of inefficient equipment utilization or performance is the wrong equipment allotted to the department, 1(4%) replied that sharing the equipment for more than 1 procedure results in inefficient use. Most of the professionals 12 (50%) replied that equipment breakdown is the major cause of the inefficient equipment utilization and 8(33%) replied lack of maintenance as the cause, this is followed by 2(8%) who replied to unavailability of spare parts as the major cause.

Equipment calibration was also the matter of concern as they were not upgraded with the change in technology as reported by most of the participants, 20 (84%), replied that they do not feel that their equipment is calibrated as per the technology change. Few participants 2 (8%) reported that equipment was not often calibrated and 2(8%) reported they are often calibrated. Out of 24 professionals, 22(92%) believed that their department lacks the technology updates, whereas 2(8%) replied that they do not believe that their department lacks the latest technology. NA was replied by 0(0%).
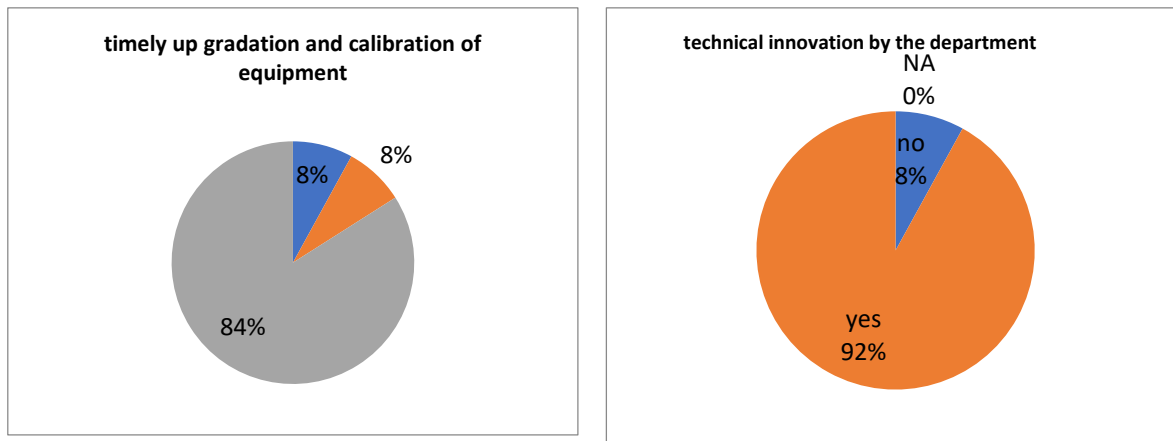
Figure 5: timely up gradation and calibration of equipment and technical innovation in the department.

Most of the respondents, 16 (66%), replied that there is a lack of supervision from their manager or senior management, whereas 5(21%) strongly agreed that their management lacks supervision. 2(8%), on the other hand, disagree that their management lacks supervision. 1(4%) strongly disagree on it.22 out of 24 respondents, 92%, replied that the equipment in their department is underutilized.

Factors Affecting the Utilization of The Equipment

Cross tabulations were used to investigate the associated factors, fisher exact analysis was employed to see if there is an average difference between factors of demographics, Human factors, equipment factors and environmental Factor. The present study found a statically significance between the years of experience and the utilization of the equipment with a P-value of 0.002; however, the age of the workforce handling the equipment was not found statistically associated with the equipment utilization. There was also significant association between the training provided to the staff and the utilization of the equipment having a P-value of 0. 003.The personal issues of the staff members affecting the capabilities of handling the equipment were found to have an insignificant association with equipment utilization. The study also reveals that factors related to the equipment itself have greater significance in the utilization of the equipment, the regular maintenance and failure of the equipment was found to be statistically significant with a P-value of 0.002 and frequent breakdowns and downtime was also found statistically associated with equipment utilization with P-value 0.002.

Moreover, study found an association between the variable utilization of the equipment in the Dental department with the technology factor, the calibration of the equipment with the change of the technology and lack of technology updates or innovation were found to be statistically significantly associated with utilization with P-value 0.005 and <0.001 respectively.

Table 2: statistical analysis of factors affecting utilization of the equipment

Equipment Utilization Variable	T value	P-value
Experience	13.7	0.002
Age of the technician	5.6	0.5
The skill of the department staff	8.3	0.003
Personal issues affecting the capabilities of staff	4.05	0.5
	0	0.002
Regular Equipment Maintenance Failures, Downtime and breakdown	13.76	0.306
Equipment Safety concerns		
	2.6	0.005
Calibrations and up gradation		
	10.8	<0.001
Technical innovation		
	21.2	

DISCUSSION

This study was conducted in public health care set up at Sunder Nagar. Total 07 equipment from the dental department which are clinically used was studied for their UC. A survey was carried out through questionnaire to find out the various factors affecting the UC of this equipment. It was verified that the most significant factors that influence the utilization of the equipment are the Human, equipment condition, and technology factors. Maintenance delay and frequent downtime and breakdown were observed in the study, which was significantly associated with the equipment utilization. According to the study, only 42% of the equipment was optimally utilized; the dental chair was the most optimally used clinical dental equipment with 75% usage among the 7 equipment. The other equipment found to be optimally utilized were the IOPA machine and ultrasonic scalars with UC 55% and 50%, respectively. The study's findings were comparable to the study by Gupta et al., 2017 which found that 50% of medical institutes were underutilized. The present study found a statically significance between the years of experience and the utilization of the equipment with a P-value of 0.002; however, the age of the workforce handling the equipment was not found statistically associated with the equipment utilization.

Dental microscope and dental Scan were found to be the least used equipment in the department. The department has only one dental scan machine and one dental microscope in the department of Endodontics which was the most underutilized equipment of the department, and it was only used at the time where complexity of case is beyond physician control and requires skilled specialist. Most of the time it was not used due to lack of technical knowledge and trained professional in the department. Endomotors were provided but lack of precision and training compelled professional to perform procedure with conventional method. This reveals the human factors were found significantly associated with equipment utilization. The study findings were similar to the study conducted by Ademe et al., which found training provided to the participants and the skill of the people handling the department as the major factor affecting the utilization of the equipment. The staff and staff training within the department were found to be the commonest cause of the underutilization, which was similar to the study by Bahreini 2016. However, the study by Chaudhary et al., 2016 has found no significant association between the workforce's skill with the utilization of the equipment.

The current study found a significant association with technology factors and maintenance factor affecting the utilization of the equipment in the department; the majority of the respondents (88%) replied that the department lacks regular maintenance affecting the equipment optimal use when required. The other factor was failure, downtime and breakdowns of the equipment affecting the utilization of the

equipment; most of the respondents, 88%, replied that the equipment in their department faces frequent downtime and failure that has impacted the utilization of the equipment. Similar results were found in the Chaudhary & Kaul, 2015 which concluded that maintenance absence or delay is the commonest cause of equipment underutilization.

There were a few limitations of the study, including the sample size, observation period, and sample characteristics. It has further limitations as answering questionnaire depends upon the acceptability and attitude towards equipment of dental professional. Dental chairs are somehow most used but its efficiency is still questionable as it is the basic and foremost equipment to work in dental office. This can be the limiting factor in utilisation coefficient. The study accounted for the clinical equipment within the dental department only; however, this study provides the further scope of study to evaluate the equipment utilization in other departments and laboratories such as radiology, pathology and surgery within the public health facility as most of the equipment was found underutilized. The small equipment sample size might affect the generalizability of the study. The self-reporting questionnaire may induce chances of reporting bias, and some of the factors may reflect over or under-reporting by the participants.

CONCLUSION

On average, the UC of equipment under study in the dental department of the public healthcare centre was 42 %. The study concluded that the 04 out of 07 clinical equipment were not used adequately. However, only 03 equipment were properly used reflecting the underutilization of this clinical equipment in the dental department. It became quite evident that the equipment utilization got affected due to lack of technical knowledge and maintenance leading to frequent breakdown. The most utilized equipment was the Dental Chair whereas, Dental microscope and Vista Scan mini were the least used equipment in the department. The technical knowledge is responsible for the management of clinical equipment that may pose limitations in the prognosis of treatment as result of improper use of equipment. 92% of the participants, 22 among the 24 respondents, replied that the equipment in their department is not optimally utilized due to various factors. This reflects a vast number of staff members conscious about the current utilization status of the equipment in their department. The experience and skilled training was also found to be associated with equipment utilization.

The statistical Fisher test runs to find the association of factors with the utilization of the equipment have found a significant influence of eth skill, training and equipment maintenance on the utilization, the technical aspects such as calibration and software updates were also found to be statistically associated with utilization of equipment. After performing statistical analysis, the study concluded that no statistical significance could be established between the factors such as miscommunication between the staff, lack of motivations and encouragement and environmental factors such as heat, moisture and rain on the utilization of the equipment. It should be the responsibility of the management and the professionals who handle and operate each equipment to maintain and provide maximum potency of device. This will also promote efficiency and speed of treatment in the digital world also provides good returns in investment.

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