

**Original Article****Open Access****Frequency and pattern of utilization of clinical microbiological laboratory services in oral and maxillofacial surgery in a Nigerian tertiary hospital**

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Abstract:

Background: Oral and maxillofacial infections can be fatal if the services of clinical microbiological laboratory (CML) are underutilized. To the best of our knowledge, it appears that the utilization of CML services have not been properly documented in literature. The objective of this study was to determine the frequency and pattern of utilization of CML services in oral and maxillofacial surgery patients in a Nigerian tertiary hospital.

Methodology: This was a retrospective cross-sectional study conducted in the department of clinical microbiology of University of Benin Teaching Hospital from January 2019 to December 2023. Data were obtained from the laboratory register and case notes of patients. Patients with incomplete data were excluded from the study. Data collected include age, gender, type of specimens, microbiological tests and services, Gram stain morphology, microbial culture growth and antimicrobial susceptibility test results. The unit of analysis was patients rather than specimens. Both descriptive and inferential statistics were performed, and *p* value less than 0.05 was considered significant.

Results: Of the total 7,345 patients seen during the study period, specimens of 79 patients were sent to CML for analysis, given a laboratory utilization rate of 1.08%. The age range of the 79 patients was 11-101 years with a mean age of 46.1±17.6 years. More than two-third (75.9%) of the patients were younger than 60 years, and just a little more than half (57.0%) were females. Bacteriology services was the most rendered service to the oral and maxillofacial patients. Male and female equally utilize the services. Also, both young and elderly patients equally utilize the services.

Conclusion: The rate of utilization of CML services in OMF surgery is relatively low. The most utilized service was bacteriology. Age and gender were not significantly associated with utilization of CML services by oral and maxillofacial patients.

Keywords: Utilization; Clinical Microbiological Services; Oral and Maxillofacial Surgery

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Fréquence et schéma d'utilisation des services de laboratoire de microbiologie clinique en chirurgie buccale et maxillo-faciale dans un hôpital tertiaire Nigérian

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Résumé:

Contexte: Les infections buccales et maxillo-faciales peuvent être mortelles si les services de laboratoire de microbiologie clinique (CML) sont sous-utilisés. À notre connaissance, il semble que l'utilisation des services de

CML n'a pas été correctement documentée dans la littérature. L'objectif de cette étude était de déterminer la fréquence et le schéma d'utilisation des services de CML chez les patients en chirurgie buccale et maxillo-faciale dans un hôpital tertiaire nigérian.

Méthodologie: Il s'agissait d'une étude transversale rétrospective menée au département de microbiologie clinique de l'hôpital universitaire du Bénin de janvier 2019 à décembre 2023. Les données ont été obtenues à partir du registre de laboratoire et des notes de cas des patients. Les patients dont les données étaient incomplètes ont été exclus de l'étude. Les données collectées comprennent l'âge, le sexe, le type d'échantillons, les tests et services microbiologiques, la morphologie de la coloration de Gram, la croissance de la culture microbienne et les résultats des tests de sensibilité aux antimicrobiens. Français L'unité d'analyse était les patients plutôt que les échantillons. Des statistiques descriptives et inférentielles ont été réalisées, et une valeur p inférieure à 0,05 a été considérée comme significative.

Résultats: Sur un total de 7 345 patients vus pendant la période d'étude, des échantillons de 79 patients ont été envoyés au CML pour analyse, étant donné un taux d'utilisation du laboratoire de 1,08%. La tranche d'âge des 79 patients était de 11 à 101 ans avec un âge moyen de $46,1 \pm 17,6$ ans. Plus des deux tiers (75,9%) des patients avaient moins de 60 ans et un peu plus de la moitié (57,0%) étaient des femmes. Les services de bactériologie étaient le service le plus rendu aux patients buccaux et maxillo-faciaux. Les hommes et les femmes utilisent ces services de manière égale. De plus, les patients jeunes et âgés utilisent ces services de manière égale.

Conclusion: Le taux d'utilisation des services du CML en chirurgie OMF est relativement faible. Le service le plus utilisé était la bactériologie. L'âge et le sexe n'étaient pas significativement associés à l'utilisation des services de LMC par les patients buccaux et maxillo-faciaux.

Mots clés: Utilisation; Services de microbiologie clinique; Chirurgie buccale et maxillo-faciale

Introduction:

Oral and maxillofacial (OMF) infection is a global health burden (1). It ranges from mild periapical infection to the deep cervicofacial infections which can be fatal if early diagnosis is missed. While some OMFs are rare, others are frequently encountered worldwide (2). The oral cavity is habitat to many normal oral microbiota but these organisms can be pathogenic if there is alteration of the ecosystem cause by non-judicious surgical procedures and immunodeficiency diseases (3).

Laboratory medicine has evolved in the both developed and developing countries over the years (4). The role of laboratory medicine in the treatment of patients in hospitals cannot be over-emphasized. One of the frequently utilized facilities in OMF surgery is clinical microbiology laboratory (CML) (5, 6). Diagnosis of infectious diseases will help to prevent under or over prescription of antimicrobials thereby reducing emergence of antimicrobials resistance (AMR) (7).

As healthcare provision continues to improve and the demands on the available facilities increase, the need for evaluating existing health systems to improve their efficiency becomes more challenging (8). Such evaluation plays a key role in improving service delivery and enabling informed distribution of resources (9). To achieve this, there is often a need to assess the demands being placed on the system, the challenges being experienced, and the successes being accomplished. A retrospective review of clinical microbiology laboratory services provided is one of the ways of ensuring optimal or improved service delivery (10,11).

Evaluation of utilization of CML services will play a very important role in policy formulation, research, improvement in servi-

ce delivery, teaching, and mentoring while also enabling prioritization and proper allocation and distribution of limited resources especially in resource-limited countries (12). A good understanding of how clinical microbiology laboratory services are utilized in the department of OMF surgery is very vital, as OMF surgical procedures can result in debilitating diseases that can be fatal if inappropriately managed following distortion of the normal oral microbiota (13-15). The lack of full understanding of the utilization of CML services especially by the OMFS, will lead to irrational prescription or inappropriate antimicrobial use thereby fueling the risk of an increased burden of AMR, a major threat to the healthcare system globally (16). The frequent and optimal utilization CML services by the physicians or surgeons in a tertiary hospital, especially in OMF surgery department will help to improve patient outcome and reduce the rate of AMR in our healthcare system.

Oral and maxillofacial infections can be fatal if the services of clinical microbiology laboratory are underutilized (17-20). To the best of our knowledge, it appears that the utilization of CML services have not been properly documented in the literature. Therefore, the aim of this study was to determine the frequency and pattern of utilization of clinical microbiological laboratory services in oral and maxillofacial surgery patients in a Nigerian tertiary hospital.

Materials and method:

Study setting and design:

This is a retrospective cross-sectional study of all patients diagnosed in Department of Clinical Microbiology and treated in Department of Oral and Maxillofacial Surgery of the University of Benin Teaching Hospital, a ter-

tiary hospital in south-south Nigeria from January 2019 to December 2023.

Data collection:

Data were obtained from laboratory register and case-notes of the patients. Patients with incomplete data were excluded from the study. Collected data were age, gender, type of specimen, and type of tests. Others data collected were type of services, presence of growth on culture, sensitivity test results and Gram staining reaction.

Statistical analysis:

Both descriptive and inferential statistics were performed. In the descriptive statistics, the categorical variables were expressed in frequencies and percentages while numerical variables were expressed in mean and standard deviation.

For the inferential statistics, Chi-square test was used to determine association between dependent and independent variables. Binary logistic regression was used to identify independent predictor(s). Data were analyzed using IBM SPSS for Windows, version 23.0 software (IBM, Armonk, New York). A value of $p < 0.05$ was considered significant.

Results:

In this study, the unit of analysis was the patients rather than specimens. Of the total 7,345 patients seen under study, specimens of 79 patients were sent to CML for analysis given a laboratory utilization rate of 1.08%. The age range of the 79 patients was 11-101 years with a mean age of 46.1 ± 17.6 years. Table 1 shows the clinico-demographic characteristics of the patients whose samples were sent for microbiological analysis. More than half ($n=60$, 75.9%) of the patients were younger than 60 years. The number of females was 45 (57.0%) compared to 34 (43%) males, given a male to female ratio of 1:1.3.

The most frequently received specimen from OMFS was pus ($n=60$, 75.9%), while the least frequent was saliva ($n=3$, 3.8%). Almost all test performed were microscopy, culture and sensitivity ($n=78$; 98.7%), compared to just 1 (1.3%) microscopy. More than half ($n=59$; 74.7%) of the services rendered by the CML to OMFS was bacteriology while no service ($n=0$; 0.0%) was observed from virology, parasitology and immunology.

Sixty-one (77.2%) samples yielded positive growth, of which only 34 (55.7%) samples yielded bacterial isolates sensitive to antimicrobial agents. Bacteria ($n=69$; 87.3%)

was most frequent of the microbes, followed by fungi ($n=10$; 12.7%) and neither virus nor parasite was found. Of the 69 bacteria isolates, 57 (86.1%) had Gram positive morphology.

Table 2 shows the pattern of utilization of clinical microbiological services by age distribution. Age was not a significant factor in the utilization of CML services in the study area ($p > 0.05$). Table 3 shows the pattern of utilization of CML by gender distribution. Gender did not significantly affect the pattern of utilization of CML services ($p > 0.05$).

Discussion:

Hospital services can either be over- or under-utilized which may be inimical to the goals of hospital best practices and mission as well as visions of the provider of the services. However, it is not known whether these services are underutilized or overutilized especially in laboratory medicines whose essential role is diagnostic. Therefore, studies as regard utilization of available services will assist in policy making and prioritization of care. This prompted this study that assessed the pattern of utilization of CML services among OMF patients in a tertiary hospital in a developing country. It is hoped that this study will help to ensure appropriate antimicrobial use in order to reduce AMR and subsequent treatment failure and promote appropriate antimicrobial prescription, which is a major component of antimicrobial stewardship.

This study highlights the features of a clinical microbiology service that makes it most useful, and which need to be prioritized. In an era of growing concern around AMR, it is essential that the resources dedicated to ensuring the appropriate use of antimicrobials are deployed effectively, particularly where those resources are limited. This study will encourage OMF surgeons to consult CML services not only by default, or when empirical therapy has failed.

The rate of utilization of CML services in OMF surgery was 1.08% and this could mean that CML services are underutilized in OMF surgery. As most infectious diseases are odontogenic in origin, policy makers may have to prioritize and make the availability of culture media of the odontogenic tissues. The mean age of patient of 46.1 years in the study, coincided with the period that odontogenic infections frequently occurred (16).

Table 1: Clinico-demographic characteristics of the patients utilizing clinical microbiology services in Oral and Maxillofacial Surgery, University of Benin Teaching Hospital, Benin-City, Nigeria

Variables	Frequency (n)	Percent (%)
Age group (years)		
≤60	60	75.9
>60	19	24.1
Gender		
Male	34	43.0
Female	45	57.0
Type of Specimen		
Pus	60	75.9
Saliva	3	3.8
Tissue	16	20.3
Type of test		
Microscopy	1	1.3
M/C/S	78	98.7
Type of services		
Bacteriology	59	74.7
Virology	0	0.0
Mycology	20	25.3
Parasitology	0	0.0
Immunology	0	0.0
Culture growth		
Positive	61	77.2
Negative	18	22.8
Sensitivity (n=61)		
Yes	34	55.7
No	27	44.3
Type of microbes		
Bacteria	69	87.3
Fungi	10	12.7
Type of bacteria (n=69)		
Gram positive	57	86.1
Gram negative	12	13.9

It is worthy to note that this study recruited all categories of patients without age limitation unlike a study (10) that the reported utilization of same services in paediatric patients. In this study, there was less utilization of CML services among the elderly and this finding is in agreement with previous study (20). This could be related to the fact that infectious diseases are less frequent in the elderly compared to non-infectious diseases such as hypertension and diabetes mellitus. Although not a significant finding, females accessed CML services more than their male counterpart. This is in line with previous studies that females present more frequently for routine medical check-ups than their male counterparts (7,10).

The fact that pus specimen was the most frequently received specimen for CML analysis is understandable as studies reported the most prevalent dental disease to be periapical abscess which is a sequela of peri-

apical periodontitis (1,3). Microscopy alone is not a common investigation in OMF surgery unlike microscopy, culture and sensitivity (m/c/s) which is almost a routine. The m/c/s results can help guide the appropriate choice of antimicrobials and thereby reduce antimicrobial resistance emergence, which has recently been recognized as a significant determining factor for morbidity, mortality and increased cost in hospitals, with optimization of antibiotic utilization as one of the strategies for battling this scourge.

The optimization of antibiotic utilization, at its most basic level, is the appropriate use of antibiotics and the limiting of unnecessary antibiotic administration/exposure, which consist of appropriate diagnosis, acquiring the appropriate culture and susceptibility data, implementing the most appropriate treatment, selecting the most effective antibiotics and dosing the antibiotics appropriately.

Table 2: Pattern of utilization of clinical microbiological services by age distribution in Oral and Maxillofacial Surgery, University of Benin Teaching Hospital, Benin-City, Nigeria

Variables	Age group (years)		χ^2	p value
	≤ 60	> 60		
Type of specimen				
Pus	44 (73.3)	16 (26.7)	1.42	0.49
Saliva	3 (100.0)	0		
Tissue	13 (81.3)	3 (18.8)		
Type of test				
Microscopy	0	1 (100.0)	3.19	0.07
M/C/S	60 (76.9)	18 (23.1)		
Type of services				
Bacteriology	46 (78.0)	13 (22.0)	0.52	0.47
Virology	0	0		
Mycology	17 (70.0)	6 (30.0)		
Parasitology	0	0		
Immunology	0	0		
Culture growth				
Positive	48 (78.7)	13 (21.3)	1.10	0.29
Negative	12 (66.7)	6 (33.3)		
Sensitivity (n=61)				
Yes	27 (79.5)	7 (20.6)	0.39	0.53
No	33 (73.3)	12 (26.7)		
Type of microbes				
Bacteria	54 (78.3)	15 (21.7)	2.41	0.30
Fungi	6 (60.0)	4 (40.0)		
Type of bacteria (n=69)				
Gram positive	45 (80.4)	11 (19.6)	3.36	0.19
Gram negative	9 (75.0)	3 (25.0)		

 χ^2 = Chi square

Table 3: Pattern of utilization of clinical microbiological services by gender distribution in Oral and Maxillofacial Surgery, University of Benin Teaching Hospital, Benin-City, Nigeria

Variables	Gender		χ^2	p value
	Male	Female		
Type of specimen				
Pus	29 (48.3)	31 (51.7)	2.93	0.23
Saliva	1 (33.3)	2 (66.7)		
Tissue	4 (25.0)	12 (75.0)		
Type of test				
Microscopy	0	1 (100.0)	0.77	0.38
Microscopy/Culture/Sensitivity	34 (43.6)	44 (66.4)		
Type of services				
Bacteriology	29 (49.2)	30 (50.8)	3.55	0.06
Virology	0	0		
Mycology	5 (25.0)	15 (75.0)		
Parasitology	0	0		
Immunology	0	0		
Culture growth				
Positive	27 (44.3)	34 (55.7)	0.16	0.69
Negative	7 (38.9)	11 (61.1)		
Sensitivity (n=61)				
Yes	16 (47.1)	18 (52.9)	0.39	0.53
No	18 (40.0)	27 (60.0)		
Type of microbes				
Bacteria	33 (47.8)	36 (52.2)	5.37	0.07
Fungi	1 (10.0)	9 (90.0)		
Type of bacteria (n=69)				
Gram positive	29 (50.9)	28 (49.1)	4.34	0.11
Gram negative	4 (33.3)	8 (66.7)		

 χ^2 = Chi square

We observed that almost all services utilized by OMF surgery in CML is bacteriology without any evidence of virology, parasitology and immunology services. This could be related to the role of bacteria in aetio-pathogenesis in most oral and maxillofacial diseases. More so, the oral cavity is a host to thousands of commensal microbiota that can become pathogenic if given the opportunity (20). Remarkably, almost half of the cultured microorganisms were resistant to commonly available antibacterial drugs. This could be attributable to pre-analytical rather than analytical factors. Antibiotic misuse, over-the-counter administration of antimicrobials and poor adherence to antimicrobial stewardship are established factors fueling AMR (16). These are the rife in Nigeria and may explain this finding. Also due to lack of similar study in the literature, this finding could not be compared. We noted in this study that retinue of the bacteria isolated were of Gram-positive morphology and this could be due to the fact that they are the most commensals in oral and extraoral regions (6,8).

Although to the best of our knowledge no study was found to investigate the factors associated with utilization of CML services in OMF surgery, we could not find an association between the studied demographic factors and the pattern of utilization of the services and the reason could be due to the fact that no person is excluded in the utilization of CML services.

Few limitations were noticed in this study. Some data could have been missed due to the current study being retrospective in nature. Furthermore, this was a single centre study, therefore, generalization of our findings should be taken with caution. Conclusively, the frequency of utilization of CML services in OMF surgery is relatively low. The most utilized service was bacteriology. Age and gender were not significantly associated with utilization of CML services by our OMF patients.

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Contributions of authors:

IJO was involved in data collection, analysis and manuscript write-up; OGI was involved in manuscript proof reading; IEE was involved in data collection and manuscript proof reading; OC was involved in the

manuscript proof reading; and EBE was involved in study conceptualization, data analysis, manuscript write-up and proof reading.

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No conflict of interest is declared.

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Data are available on request

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