Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2014, 6(9):261-266

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Descriptive and multivariate analysis of microbial environmental monitoring of the hospital in the area Rharb, Kenitra (Morocco)

Majdouline Larif[1*], Nabila Saouide El ayne[2], Adil Echchelh[2], Abdelaziz Chaouch[3] and Abdelmajid Soulaymani[4]

[1]Laboratory methods of separation, Faculty of Sciences, University IbnTofail, Kenitra, Morocco
[2]Laboratory of Electrical and Power Engineering, Faculty of Sciences, University IbnTofail, Kenitra, Morocco
[3]Biotechnology Laboratory, Environment and Quality, Faculty of Sciences, University IbnTofail, Kenitra, Morocco
[4]Laboratory of Genetics and Biometry, Faculty of Sciences, University IbnTofail, Kenitra, Morocco

---

ABSTRACT

The environment is implicated as a source of healthcare-associated infections (HAIs) and there is a need for evidence-based approaches to environmental sampling to assess cleanliness and improve infection prevention and control. Our objective is to study the basic principles of prevention and control of the infections that may be acquired in health-care facilities (but does not address other aspects of hospital hygiene (Region Rharb, Kenitra, Morocco)and safety such as pressure sores and the risk of falls). The multivariate statistical techniques (i.e., principal component analysis (PVA), the multiple linear regression (M LR) and partial least square (PLS) have been used to evaluate the pattern of the relationship among variables. The ACP allowed us to observe two groups (GA) correlation between the different services and the group germs (GB) where there is predominance of bacteria: Bacillus and Klebsiela pneumoniae in service resuscitation. Partial least square regression (PLS) and the (MLR), have shown a correlation coefficient respectively of 0.999 and 0.995.The regression model obtained suggested that the proposed combination could be useful for predicting the total percentage of different bacteria. The predicted values of activities are in good agreement with the experimental results.

Keywords: Nosocomial infection, Environmental hygiene, Microbiological controls, ACP, MLR, PLS.

INTRODUCTION

Management of health-care waste is an integral part of hospital hygiene and infection control. Health-care waste should be considered as a reservoir of pathogenic microorganisms, which can cause contamination and give rise to infection. If waste is inadequately managed these microorganisms can be transmitted by direct contact, in the air, or by a variety of vectors. Infectious waste contributes in this way to the risk of nosocomial infections, putting the health of hospital personnel and patients, at risk[1,2].

Patients undergoing colorectal surgical resections have a high incidence of surgical site infection (SSI). Many patient-specific risk factors have been recognised in association with SSI in such patients, but environmental contamination is increasingly recognised as a contributor to hospital-acquired infection (HAI). This study set out to describe the bacterial contamination of the patient environment, using hospital bed-control handsets, as they are frequently handled by both staff and patients and represent a marker of environmental contamination *Staphylococcus aureus* is the most common bacterial species implicated as a cause of surgical site infection (SSI) [3,4].Many types of pathogenic micro-organisms have been found on a variety of common hospital surfaces including:(bed, sink, toilet, wall, rails, call button, stretcher)[5,6] *Klebsiella pneumoniae* (bed frame, over-bed table, bedcovers, drains, sinks) [7,8].

S. aureus (air, mattress cover, bathroom floor, bed linen, chairs, table, floor) [9-11] and A. baumannii (bed rails, sinks, tables, curtains, door handles)[12].

Our objective is to study the basic principles of prevention and control of the infections that may be acquired in health-care facilities (but does not address other aspects of hospital hygiene and safety such as pressure sores and the risk of falls).

The multivariate statistical techniques principal component analysis (PCA), the multiple linear regression (MLR) and partial least square (PLS) have been used to evaluate the pattern of the relationship among variables [8,11]. The predicted values of activities are in good agreement with the experimental results.These statistical techniques and exploratory data analysis are the appropriate tools for a meaningful data reduction and interpretation of multi-consistent physical and chemical measurements.

EXPERIMENTAL SECTION

Material

A qualitative and quantitative study of microbiological control was conducted over a period of seven months from 1 January 2013 à 31 July 2013 at the Kenitra hospital with a total bed capacity 418 beds (table 1). According to ISO / DIS 14698-1, we used the method swabbing in two specific cases: looking very germs specific on flat surfaces and non-planar) [13]. Swabs should were remising in his cases protectors and were sent to the laboratory within a quarter time. In total we conducted 210 samples.The colonies were identified using standard keys and Bergey's Manual of Systematic Bacteriology 1984. Each sample was repeated 3 times and identified.

Table 1: Percentage of the different isolated germs according services

Services	BAC	SCN	SA	KP	PO	EC	PV	Total %
Réanimation	11(20%)	9(17%)	10(18%)	11(20%)	10(19%)	0	3(6%)	54
Traumatology	4(18%)	7(35%)	8(35%)	3(12%)	0	0	0	22
Emergencies	4(20%)	4(20%)	5(25%)	4(20%)	0	3(15%)	0	20
Operatingblok	6(37%)	3(19%)	5(31%)	2(13%)	0	0	0	16
Surgery	5(31%)	6(37%)	0	3(19%)	0	2(13%)	0	16
Medicine	5(31%)	6(37%)	0	3(19%)	0	2(13%)	0	16
Pneumo-phtysiologie	5(13%)	6(37%)	3(19%)	2(13%)	0	0	0	16
Maternity	3(27%)	4(37%)	4(36%)	0	0	0	0	11
Pédiatrics	3(23%)	2(15%)	3(23%)	3(23%)	0	2	0	13
Maternityblok	5(55%)	3(25%)	2(18%)	0	0	0	0	11

***BAC** :Bacilus ;**SCN** : Staphylocoques coagulases négative ; **SA** :Staphylocoque :aurus ;**KP** :Klebsielapneumoniae ; **PO** :Pseudomonas oeruginosa ;**EC** :Enterobactercloacae ;**PV** :Proteusvulgarisand**Total%** : Total pourcentage of bacteria.*

Proteus vulgaris and *Pseudomonas aeruginosa*was isolated only in pipes and liquid respirators,*Enterebacter cloacae* in level trolleys and bedside tables. By cons that*Klebsiela pneumoniae and Staphylococci aureus*were isolated from all surfaces and targeted medical devices.

Computational methods

Principal components analysis

The multivariate statistical techniques such as Principal Component Analysis (PCA) have largely were used as unbiased methods in the analysis of the prevention and control of infections that can be acquired in health care facilities him and give useful information,) [14,15]. PCA is a fundamental right and one of the most popular multivariate statistical based on monitoring methods.

Multiple linear regressions (MLR)

Linear regression is the study of the relationship between a dependent variable and several independent variables. The multiple linear regression (MLR) is generated using the XLSTAT, version 2009 software to predict Total%.

The optimal number of components (N) is employed to do validation MLR analysis to get the final model parameters such as correlation coefficient R^2, standard deviation (S) and Fischer test value (F)[16].

Partial least square analysis (PLS)

The PLS have two objectives: to approximate the matrix X of molecular structure descriptors to the matrix Y of dependent variables and to maximize the correlation between them. The leave-one-out (LOO) method[16] was used to perform the cross-validated analysis. The optimal number of components (N) is employed to do non-validation PLS analysis to get the final model parameters such as correlation coefficient R^2[17], standard deviation (S) and Fischer test value (F).

RESULTS

Principal component analysis (training set selection)

Descriptive analysis

Correct for statistical analysis, we considered from table 1 that the bacteria that are in great numbers in various services such as (*Bacillus*, SCN, and *Klebsielaaurus Staphylococcus pneumoniae*) (Table 2).

Table 2:**Descriptive analysis of the percentages of the various germs isolated according to services**

Variable	Minimum	Maximum	Moyenne	Ecart-type
Total%	11,000	54,000	19,500	12,616
Bacilus	3,000	11,000	5,100	2,283
SCN	2,000	9,000	5,000	2,160
Staphylocoque aurus	0,000	10,000	4,000	3,197
Klebsielapneumoniae	0,000	11,000	3,100	3,071

Matrix of correlation (Pearson (n))

The first two principal axes are sufficient to describe the information provided by the data matrix. Indeed, the percentages of variance are 77,38% and 11,82% for the axes F1 and F2 respectively. The total information is estimated to a percentage of 89.20%. The principal component analysis (PCA) [14-18,19] was conducted to identify the link between the different variables. Bold values are different from 0 at a significance level of p = 0.05.

The Pearson correlation coefficients are summarized in the following (Table 3). The obtained matrix provides information on the negative or positive correlation between variables.

Table 3: Correlation matrix (Pearson (n)) between different germs

Variables	Total%	*Bacillus*	SCN	*Staphy aureus*	*Klebsiela pneumonie*
Total%	**1**				
Bacilus	**0,889**	**1**			
SCN	**0,750**	**0,653**	**1**		
Staphylocoque aurus	**0,741**	0,518	0,434	**1**	
Klebsielapneumoniae	**0,959**	**0,822**	**0,687**	0,622	**1**

Bold values are different from 0 at a level significant for p < 0.05;At a very significant for p < 0,01;At a highly significant to p < 0,001

DISCUSSION

Test de sphéricité de Bartlett

Khi² (observed value)	46,368
Khi² (critical value)	18,307
DDL	10
p-value	< 0,0001
alpha	0,05

Test interpretation

H0: There is no significant correlation between the different variables of 0.

Ha: At least one of the correlations between the variables is significantly different from 0.

Since the p-value calculated is less than the significance level alpha = 0.05, we should reject the null hypothesis **H0** and the alternative hypothesis Ha remember.

The risk of rejecting the null hypothesis **H0** when it is true is less than 0.01%.

Cartesian diagram

-From Figure 1 it is observed that Total% is highly correlated with all the germs *Bacillus*, SCN, *Staphylococcus pneumoniae*aurus and *Klebsiela*(GA).

-At the level of services trauma and resuscitation there is a strong correlation between all of the bacteria (Figure 1) which could be explained by the predominance of bacteria compared to other services (GA).

It is found that *Bacillus* and *Klebsielapneumoniae* are highly correlated with the resuscitation department (GB) which could be explained by the predominance in the resuscitation department (Table 1).

Could explain this contamination by contact of the hand as an important reservoir of microorganisms. These micro-organisms may then be transmitted via the hands to other inanimate objects or to patients[20].

Extensive environmental contamination has been demonstrated in numerous outbreaks. Colonized sites have included bed rails, bedside tables, surfaces of ventilators, sinks, suction equipment, mattresses, resuscitation equipment, curtains, slings for patient lifting, mops, buckets, door handles, stethoscopes, incubators, and computer keyboards. The colonization of respiratory tract equipment and devices has been common[21].

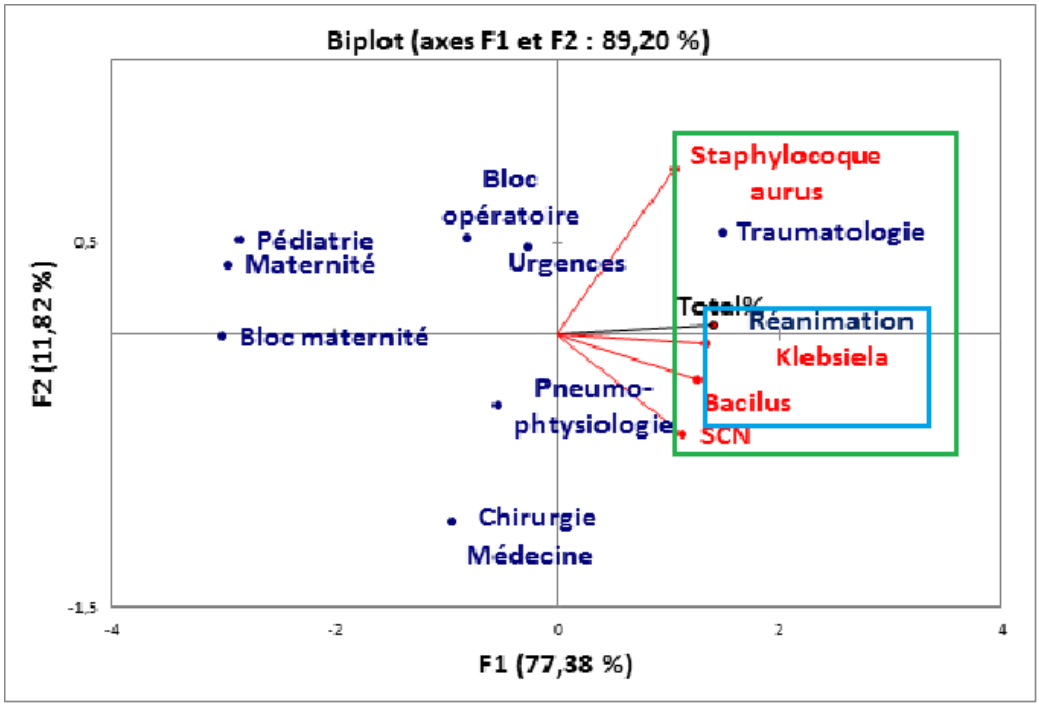

Figure 1: Cartesian diagram according to F1 and F2representing correlation between different services and bacteria

Multiple linear regressions (RLM)

To propose a mathematical model to quantitatively assess the hospital control of all the germs present in 10 services, we submitted the data matrix consists obviously from 10 hospital services based on the percentage of the five seed, a progressive multiple regression analysis. This method uses the coefficients R, R^2, and F values to select the best performance regression. Where R is the correlation coefficient; R^2 is the coefficient of determination; MSE is the mean square error; F is the Fisher F-statistic. Treatment by multiple linear regression is more accurate because it allows you to connect the structural descriptors for each activity of 10 molecules to quantitatively evaluate the effect of substituting [14].

Total% = -1,896+1,503.***Bacilus*** + 0,727.***SCN***+0, 9121.***Staphylocoqueaurus*** + 2,078. ***Klebsiela pneumonia*****(Equation 1)**

The equation 1 shows a very regular distribution of percentages of total germs, depending on the experimental values. The obtained coefficient of correlation in equation 1 is quite interesting R = 0,995.

N = 10 R^2 = 0,992 R=0,995 RMCE = 1,512

Table 4: Analyses of variance

Source	DDL	Sun of square	Mean square	F	Pr> F
Modèle	4	1421,062	355,266	155,304	<0,0001
Erreur	5	11,438	2,288		
Total corrected	9	1432,500			

As a remark (Table 4), the model the values are different from 0 at a significant level p < 0.05 for Pr<0,001 with $F_{(4,5)}$ = 155,304. The figure 2 shows a very regular distribution of percentages of total germs, depending on the experimental values.

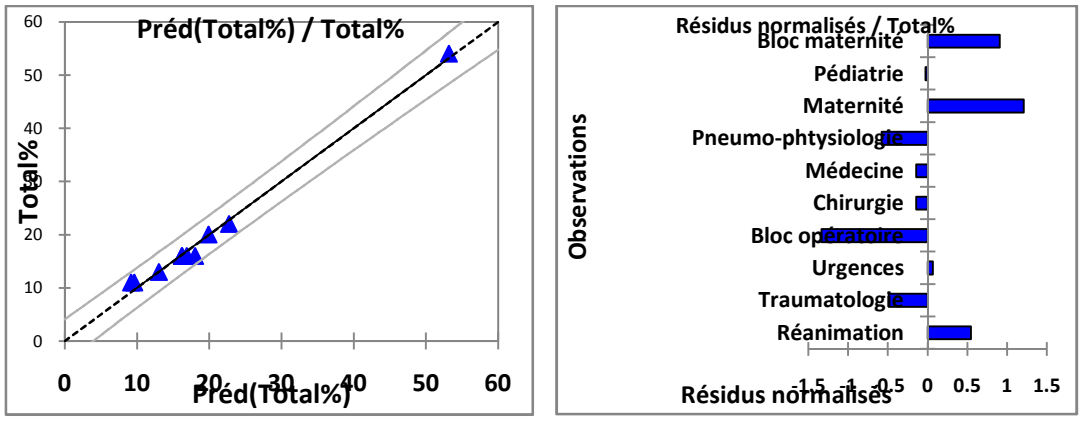

Figure 2: Graphical representation of the calculated and observed values of total percentage germs and their residues established by MLR

Partial least square analysis (PlS)

To linearly correlate the Total%: *Bacilus, SCN, Staphylocoqueaurus,.Klebsielapneumoniae*the following equations 2 was used:

Total% = -2,840+1,783.***Bacilus***+0,698.***SCN***+1,0695.***Staphylocoqueaurus***+1,767.***Klebsiela pneumoniae***(**equation 2)**

N =10 R^2 = 0,990 R=0,999 RMCE = 1,412

The correlation coefficient obtained in equation (2) is very interesting (0,999). To maximize the level of error deviation and better building our model finish.

As part of this conclusion, we can say that the total percentage values obtained from PLS regression are highly correlated to that of the total % observed in comparing the results obtained by the MLR method.The figure 3 shows a very regular distribution of Total% values depending on the experimental values.

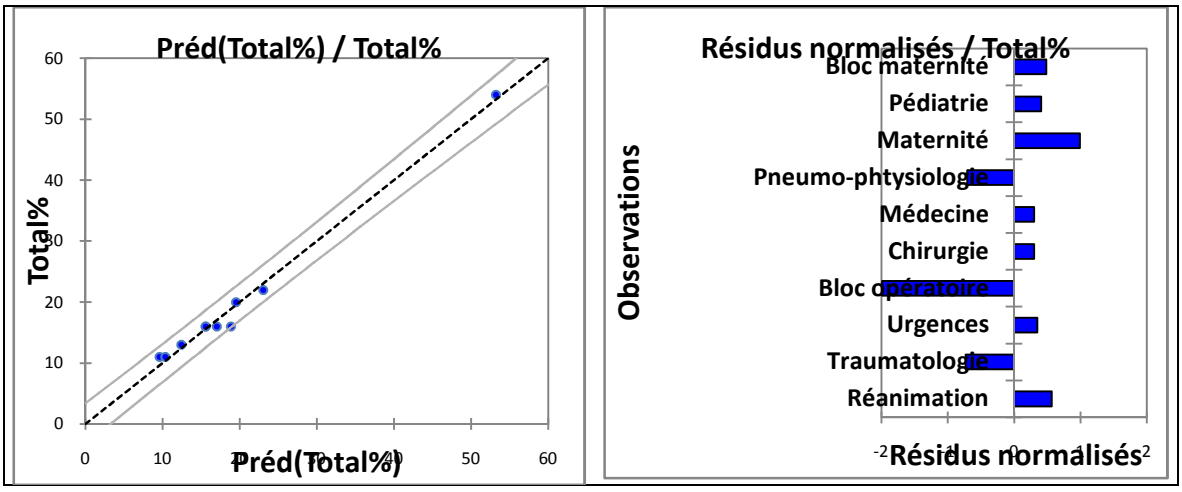

Figure 3: Graphical representation of the calculated and observed values of total percentage germs and their residues established by partial least squares regression (PLS)

Table 5 shows the comparison of observed values with the calculated values of the MLR and PLS. The predicted values of activities are in good agreement with the experimental results.

Table 5: Observed values and calculated of Total% according to different methods

Services	Total%	Préd(Total%) PLS	Résidu PLS	Préd(Total%) RLM	Résidu RLM
Réanimation	54,000	53,190	0,810	53,174	0,826
Traumatology	22,000	23,037	-1,037	22,741	-0,741
Emergencies	20,000	19,500	0,500	19,902	0,098
Operating blok	16,000	18,834	-2,834	18,024	-2,024
Surgery	16,000	15,565	0,435	16,221	-0,221
Medicine	16,000	15,565	0,435	16,221	-0,221
Pneumo-phtysiologie	16,000	17,007	-1,007	16,878	-0,878
Maternity	11,000	9,579	1,421	9,171	1,829
Pédiatrics	13,000	12,415	0,585	13,041	-0,041
Maternityblok	11,000	10,308	0,692	9,627	1,373

CONCLUSION

The APC allowed us to observe two groups (GA) correlation between the different services and the group germs (GB) where there is predominance of *bacteria: Bacillus* and *Klebsielapneumoniae* in service resuscitation. Partial least square regression (PLS) and the (MLR), have shown a correlation coefficient respectively of 0.999 and 0.995.In conclusion the essential measure in preventing the spread of nosocomial infections is isolation of infected patients. The term isolation covers a broad domain of measures. The strictest form of isolation is applied in case of very infectious diseases (e.g. haemorrhagic fever, diphtheria); less stringent precautions can be taken in case of diseases such as tuberculosis, other respiratory infections, and infectious diarrhoea. Isolation of any degree is expensive, labour-intensive, and usually inconvenient or uncomfortable for both patients and health-care personnel; its implementation should therefore be adapted to the severity of the disease and to the causative agent. Disease-specific precautions should include details of all the measures (private room, wearing of masks or gowns, etc.) to be taken in the case of a specific disease caused by a defined organism.

Acknowledgment
We are grateful to the "Association Marocaine des ChimistesThéoriciens" (AMCT) for its pertinent help concerning the programs.

REFERENCES

[1] JMBoyce;G Potter-Bynoe,C Chenevert; T King . *Infect Control HospEpidemiol.***1997**,18, 622-627.
[2]SJDance;, M Coyne;C Robertson;A Thomson;A Guleri;S Alcock,*J Hosp Infect.***2006**, 62,200-206.
[3]HGuet-Revillet;A Le Monnier;N Breton et al., *Infect Control* **2012**Feb 9 [Epub ahead of print].
[4]E GBeck;P Schmidt, Hygiene imKrankenhaus und Praxis. [Hygiene in the hospital and in medical practice.], **1986,** Berlin, Springer.
[5]G Martirosian,*J ClinMicrobiol*,**2006**, 44, 1202-1203.
[6]JAOtter; G L French, *J ClinMicrobiol*, **2009**, 47, 205-207.
[7]A Touati;KZenati;LBrasme;S. Benallaoua; C De Champs,*J Hosp Infect*, **2010**, 75, 78-79.
[8]R PHobson;F M MacKenzie; I M Gould,*J Hosp Infect*,**1996**, 33, 249-262.
[9]A CShore;A SRossney;P MKinnevey; et al.,*J ClinMicrobiol*,**2011**, 48, 1839-1852.
[10]K J Hardy;B AOppenheim;SGossain;FGao;P MHawkey,*Infect Control HospEpidemiol*.**2006**, 27, 127-132.
[11]N Asoh; H Masaki;H Watanabe et al.,*Intern. Med*.,**2005**, 44, 41-45.
[12]D J Weber;W ARutala;M B Miller;K Huslage;ESickbert-Bennett,*Am. J. Infect.Control.*, **2010**, 38, S25-S33.
[13]ASPEC. Etablissements de santé. Contrôle de l'environnement dans les zones à hauts et très hauts risques infectieux. **1999**, 47 p.
[14] M Larif;A Adad; RHmamouchi;A I Taghki; A Soulaymani;A Elmidaoui;M Bouachrine; TLakhlifi, article in press in *Arabian Journal of Chemistry***2013**,http://dx.doi.org/10.1016/j.arabjc.2012.12.033.
[15] D A Wunderlin;M P Diaz;M VAme; A C Pesce;A CHued and M ABistoni,*Water Res*.,**2001**,35, 2881–2894.
[16] C Rücker; G Rücker; M Y Meringer,*J. Chem. Inf. Model*.,**2007**, 47, 2345-2357.
[17] N T Nguyen,*Advanced Methods for Inconsistent Knowledge Management Springer*-Verlag London, **2009**.
[18] M Larif ;ASoulaymani ; AElmidaoui,*J. Mater. Environ*. Sci., **2013**, 4 (3), 432-441.
[19] PKunwar Singh; A Malik; D Mohan; SSinha, *Wat. Res*., **2004**, 38, 3980–3992.
[20] DJonathan;MD Katz,*Anesthesiology Clin N Am*., **2004**, 22, 457 – 471.
[21] J AMartinez;R Ruthazer;K Hansjosten;L Barefoot;DR Snydman,*Arch.Intern. Med.*,**2003**, 163, 1905-1912.