



CORRELATION BETWEEN CLEANING/DISINFECTION SURFACE MONITORING METHODS IN PRIMARY HEALTH CARE

CORRELAÇÃO ENTRE MÉTODOS DE MONITORAMENTO DA LIMPEZA/DESINFECÇÃO DE SUPERFÍCIES NA ATENÇÃO PRIMÁRIA À SAÚDE

CORRELACIÓN ENTRE MÉTODOS DE MONITOREO DE LA LIMPIEZA/DESINFECCIÓN DE SUPERFICIES EN LA ATENCIÓN PRIMARIA A LA SALUD

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ABSTRACT

Objective: to evaluate the correlation between the monitoring methods (visual inspection, adenosine triphosphate, and colony forming units) of the process of cleaning and disinfecting surfaces of a Family Health Strategy. **Method:** this is a prospective, analytical study with a quantitative approach. Data analysis was driven by Spearman correlation tests, Fisher exact test and receiver operating characteristic (ROC) curve. The choice of surfaces with a high frequency of contact with patients or professionals was chosen. Correlation evaluations considered the results of cleaning monitoring methods before and after performing cleaning/disinfection of five surfaces. **Results:** a significant correlation between ATP quantification and aerobic microbial counts was observed only for the patient's bed surface ($r=0.649$, $P=0.001$). The accuracy of the visual inspection was low, so it would not be the ideal method to evaluate surface cleaning. **Conclusion:** there was a significant correlation in only one surface with the ATP method and aerobic microbial count. Visual inspection did not prove to be a reliable method of monitoring the evaluated surfaces. **Descriptors:** Contamination of Equipment; Hospital Cleaning Service; Nursing Audit; Staphylococcus Aureus; Disinfection.

RESUMO

Objetivo: avaliar a correlação entre os métodos de monitoramento (inspeção visual, adenosina trifosfato e unidades formadoras de colônias) do processo de limpeza e desinfecção de superfícies de uma Estratégia de Saúde da Família. **Método:** estudo prospectivo, analítico, com abordagem quantitativa. A análise dos dados foi direcionada pelos testes de correlação de Spearman, teste exato de Fisher e curva *receiver operating characteristic* (ROC). Optou-se pela escolha de superfícies com alta frequência de contato pelos pacientes ou profissionais. As avaliações das correlações consideraram os resultados dos métodos de monitoramento da limpeza antes e após a execução da limpeza/desinfecção de cinco superfícies. **Resultados:** observou-se a presença de correlação significativa entre os métodos de quantificação de ATP e contagem microbiana aeróbia apenas para a superfície maca do paciente ($r=0,649$, $P=0,001$). A acurácia da inspeção visual foi baixa, por isso não seria o método ideal para avaliar a limpeza das superfícies. **Conclusão:** houve correlação significativa em apenas uma superfície com o método de ATP e contagem microbiana aeróbia. A inspeção visual não se mostrou um método confiável de monitoramento das superfícies avaliadas. **Descritores:** Contaminação de Equipamentos; Serviço Hospitalar de Limpeza; Auditoria de Enfermagem; Staphylococcus aureus; Desinfecção.

RESUMEN

Objetivo: evaluar la correlación entre los métodos de monitoreo (inspección visual, adenosina trifosfato y unidades formadoras de colonias) del proceso de limpieza y desinfección de superficies de una Estrategia de Salud de la Familia. **Método:** estudio prospectivo, analítico, con enfoque cuantitativo. El análisis de los datos fue dirigido por los tests de correlación de Spearman, test exacto de Fisher y curva *receiver operating characteristic* (ROC). Se optó por la elección de superficies con alta frecuencia de contacto por los pacientes o profesionales. Las evaluaciones de las correlaciones consideraron los resultados de los métodos de monitoreo de la limpieza antes y después de la ejecución de la limpieza/desinfección de cinco superficies. **Resultados:** se observó la presencia de correlación significativa entre los métodos de cuantificación de ATP y conteo microbiano aerobio apenas para la superficie de la camilla del paciente ($r=0,649$, $P=0,001$). La precisión de la inspección visual fue baja, por eso no sería el método ideal para evaluar la limpieza de las superficies. **Conclusión:** hubo correlación significativa en apenas una superficie con el método de ATP y conteo microbiano aerobio. La inspección visual no se mostró un método confiable de monitoreo de las superficies evaluadas. **Descriptor:** Equipo de contaminación; Servicio de Limpieza del Hospital; Auditoría de Enfermería; Staphylococcus aureus; La Desinfección.

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INTRODUCTION

Studies show the contaminated environment as a relevant aspect to favor the occurrence of infections related to health care.¹⁻⁴ Aspect that can be evidenced by the presence of microorganisms of epidemiological relevance, frequently found on health care surfaces, among Methicillin-resistant *Staphylococcus aureus* (MRSA), Vancomycin-resistant Enterococci (VRE), and *Clostridium difficile* spores can remain on the surfaces for a long time under favorable conditions.

It is necessary to invest human and financial resources in the process of cleaning and disinfection to reduce the impacts of the environmental factor on the transmission of pathogens (L/D) of the surfaces^{4,7}, especially the surfaces that have a high frequency of contact by the hands of professionals and patients, which function as a reservoir of microorganisms, for example, sinks, ventilators and bed rail.⁸

Among the measures used to improve the surface L/D process, there is the feedback to the team through the monitoring process.^{4,8} It is emphasized that the adoption of this strategy will depend on the epidemiological characteristics of each service, but it is essential to monitoring of the cleaning process to verify the efficiency of the process performed and to maintain acceptable cleaning standards.^{3,7}

It is possible to find studies that used methods to monitor the L/D process of the surfaces, such as the measurement of the amount ATP Bioluminescence (Adenosine Triphosphate), count of colony forming units (UFC), count of aerobic colonies, visual inspection and the choice of method will depend on the criteria to be evaluated, for example, the presence of resistant microorganisms, a result available for immediate feedback from the team, financial resources and the structure available in the institution for the evaluation.

In this context, the objective is to evaluate the correlation between the monitoring methods (visual inspection, adenosine triphosphate, and colony forming units) of the process of cleaning and disinfecting surfaces of a Family Health Strategy.

METHOD

This is a prospective, analytical and comparative study, with a quantitative approach, carried out in June 2015, in a health unit where two teams of Family Health

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Strategy work, totaling in the area of coverage 1,725 families registered.

The sample was a non-probabilistic convenience, and only those surfaces with a high frequency of contact were considered eligible, either by patients or professionals of the institution. Based on the surfaces with higher frequency of contact have a greater risk of environmental contamination, the reinforcement in cleaning and disinfection activities is indicated.¹¹

The five surfaces selected for the study were dressing gown, reception desk, gynecological table, patient's bed (vaccine room) and nursing consultation table. Samples were collected for visual inspection, ATP-bioluminescence and Colony Forming Units (UFC) methods. Thus, 10 samples per day were collected on surfaces, being 5 before and 5 after the L/D process, occurring 2 twice per week, in 3 months of collection, resulting in 240 evaluations by monitoring methods, totaling 720 evaluations in general.

It was decided to carry out the pre-cleaning collections before the staff responsible for this activity entered the rooms.¹² Next, 10 minutes after the L&D process was carried out by the sanitation team, to collect the post-cleaning, allowing product action.¹³

For the visual evaluation, items proposed in several studies were unified to consider a surface as dirty. The presence of one of these items is indicative of disapproval: stain, dust, waste (organic matter or not), fats, residues of glue, fingerprints or moisture.^{3,14-15}

ATP monitoring has been used in the food industry and in European hospital institutions to measure the quality of the cleaning process.¹⁶ The ATP measurement method was developed by the bioluminescence technique using a 3M™ (Clean-Trace ATP System) and the manufacturer's instructions, to perform the definition of this quantitative in Relative Light Units (URL). The system swab was used, passing them in an area of 100cm², at a 30° angle with zigzag movement, in the horizontal and diagonal directions. Subsequently, the swab was placed in a cuvette containing an enzymatic complex, luciferin-luciferase, which triggers a reaction, producing Relative Light Units (URL). This technique allows identifying the presence of organic matter in the surfaces.^{12-13,17}

For the monitoring of total aerobic microorganisms, contact plates or Rodac Plate® were chosen, which are composed of tryptone soybean agar (24 cm²). Each plate has a capacity between 15 and 20 ml, of which 16 ml is a quantitative ideal. The plates

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were pressed for 10 seconds on the surfaces evaluated. Subsequently, they were inserted into the incubator at a temperature of 37° C for 48 hours. After that, the readings were expressed in Colony Forming Units (UFC).¹⁸

From the studies, the approved areas were considered when ATP <250 URL, in relation to the microbiological analysis <2.5 UFC/cm².^{10,13-15,18-23} All statistical tests were applied with level of significance of 5% or P<0.05 and the software used was Minitab 17 (Minitab Inc.) and MedCalc 16.8 (MedCalc®). Data analysis was guided by Fisher's exact tests for two proportions to observe differences in the evaluation of surfaces by visual inspection, the Spearman correlation test with the purpose of observing the general correlation between the ATP quantification and the microbial count of all the surfaces evaluated independently of the phase, the Receiver Operating Characteristic (ROC) curve

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with the objective of verifying which quantitative method is most effective in determining the cleaning quality of a surface in the method of visual inspection.

This study was approved by the Ethics and Research Committee with Human Beings of the Federal University of Mato Grosso do Sul, Brazil (CAAE: 37896414.9.0000.0021), and its development complied with national and international standards of ethics in research.

RESULTS

At the end of each stage, 240 evaluations were obtained, representing a total of 720 evaluations performed at the end of phases I, III and IV, considering the three monitoring methods: visual, ATP Bioluminescence and UFC. The correlation between the ATP (RLU) and microbial counts (UFC), regardless of the phase evaluated, was calculated using the Spearman correlation test (Figure 1).

Surfaces	Spearman coefficient	Valor P
Reception desk	0.111	0.607
Patient´s bed	0.649	0.001
Gynecological table	0.126	0.558
Dressing gown	0.124	0.563
Nursing consultation table	0.243	0.253

Figure 1. Spearman correlation coefficient for surfaces evaluated independently of the studied phase. Três Lagoas (MS), Brazil (2015)

The results show the presence of a significant correlation between ATP quantification and aerobic microbial counts only for patient bed (P=0.001), with Spearman's correlation coefficient equal to AR=0.649, indicating that the higher the ATP quantification, the higher the microbial count, that is, the correlation is linear and positive (Figure 1).

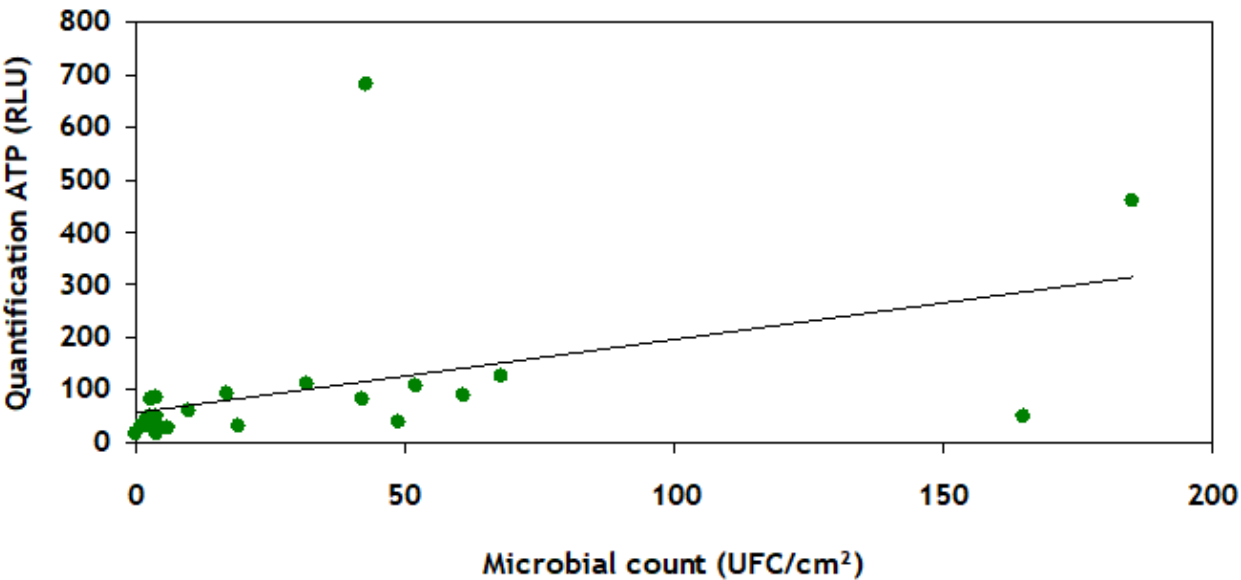


Figure 2. Spearman correlation coefficient for surfaces evaluated independently of the studied phase. Três Lagoas (MS), Brasil (2015)

For the ROC analysis, an approach was used for the evaluation of ATP quantification methods and visual inspection in the “gold

standard” microbial counts exposed in Figure 3.

Method	Characteristics of the test to determine dirty surface (%)				
	Sensitivity	Specificity	VPP†	VPN‡	Accuracy
Visual inspection	2.,6	89.4	70.8	54.6	57.5
ATP* (<250 URL/cm2)	67.0	81.5	78.4	71.2	77.6

*ATP-bioluminescence; † Positive Predictive Value; ‡ Negative Predictive Value

Figure 3. Characteristics of non-microbiological methods according to microbiological culture for the definition of clean or dirty surfaces. Três Lagoas (MS), Brazil (2015)

The results show that the ATP quantification is the most appropriate method to use as a parameter when the microbial count is considered the gold standard of surface analysis ($P < 0.001$). For this analysis, it is suggested that surfaces that present ATP Bioluminescence above 48 URLs may be considered to have failed.

DISCUSSION

Another study²⁵ evidenced in its results a significant association between visual inspection and ATP. The results differ from those found in another study²⁴, in which the existence of correlation before cleaning and non-correlation after cleaning and disinfection of the surface between the URL and UFC monitoring methods were identified. It is pertinent to highlight that the results of the measurement of the ATP of the same surface can show variations of their values due to the day in which the surfaces are evaluated, time of the last cleaning, divergence of the waiting time for data collection, besides the Inconsistency of the cleaning process performed by professionals.²⁵

Based on this premise, it is possible to observe the absence of a consensus that would be the best cleaning/disinfection monitoring method for achieving the efficiency of the cleaning/disinfection process of hospital surfaces. The few comparative studies, mainly among the most used methods, such as the ATP measurement and the older methods (visual inspection), are added to this scenario. However, environmental control is critical to mitigating health care-related infections.¹³

Therefore, it is vitally important that each service analyzes the cost-benefit, impact, limitations of each L/D monitoring method, as well as the tools, systems, human and educational resources available to adequately meet the cleanliness standards.²⁶ It is important to point out that the monitoring done by the visual inspection in this investigation was carried out by the same researcher, ensuring that a standardization of the evaluation criteria was done, as was done in other studies.^{13,25}

Other relevant aspects correspond to the risk of acquiring an IRAS resulting from

primary health care, which currently raises concern since in the rooms of these units several procedures are developed, which may favor the creation of potential reservoirs of microorganisms.²⁷ However, in the literature, there are few reports of risks related to health care in the context of primary health care, even though this is a place where health care is carried out, for example: a Pap smear, IUD insertion, cauterization of the uterine cervix, verification of capillary glycemia, inhalations, topical wound therapy, administration of medications, among others.²⁸

It is necessary to understand the attributes and items required for the development of each surface L/D monitoring method, for example, the use of the UFC that requires laboratory availability for the analysis, and provide the results only after 48 hours, extending the feedback to the team.⁴ Although this method is useful, it is important to identify the resistance of the microorganisms found to determine the microbiological patterns found on the surfaces.¹⁸ About some facilities of the ATP method, it is pointed out the immediate quantitative result of the L&D process, favoring the process of evaluation and improvement of the performance of the practices performed. However, it has disadvantages like the cost to its performance due to the need to purchase several inputs for its performance.⁴

Another method used for the monitoring corresponds to the fluorescent markers having its low cost as an advantage when compared to other methods of monitoring. However, the fact that it requires its collation on the surface without the knowledge of the team, in a secret way is a disadvantage, besides this method, does not identify the presence of microorganisms on the surface.⁴

As for the ROC curve obtained in this research, it was possible to observe that ATP Bioluminescence is the most appropriate method to use as a parameter when the microbial count is considered the gold standard of surface analysis ($P < 0.001$). In another investigation⁵, in which the aerobic culture was also used as a “gold standard,” it was identified that the visual evaluation had

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greater sensitivity and lower specificity, compared to the microbial culture, showing that when used alone the visual inspection ends up considering a surface even if it is contaminated.

In this investigation, it was also obtained that the sensitivity of the ATP test Bioluminescence was higher than the sensitivity of the visual inspection test, considering the microbial count as “gold standard” (Figure 3). Thus, the ATP bioluminescence test presents a greater chance of determining clean and dirty surfaces when related to the microbial counting test when compared to the visual inspection test. It is worth mentioning that the choice of aerobic culture as “gold standard” is associated with the fact that it allows the recovery of disease-causing microorganisms.⁵

Regarding specificity, indicating the occurrence of the true negative (dirty in one method and dirty in another method), both data presented high percentages, so it is possible to infer that both the visual inspection test and the ATP test showed agreement in the dirty surfaces. In this study, the specificity values for visual inspection and ATP were 89.4% and 81.5%, respectively, percentages not similar to those found in the study²⁹ performed in the hospital context, which obtained 52% and 44% respectively, or the values obtained in this investigation indicating both the visual inspection and the ATP tests have the quality to determine dirty surfaces when the “gold standard” is considered the microbial count test.

As for the positive and negative predictive values, indicating the probability (based on the results) of the surface being clean when it is clean (positive) or dirty (negative), they show a higher value for the ATP test. Thus, the ATP test has a higher probability of occurrence of true positive/negative values in the aerobic colony count (CCA) test. It is also noted that the accuracy of the visual inspection is low, so it would not be the ideal test to observe cleaning of surfaces, and it is necessary to employ a quantitative test. It is pertinent to point out the limited comparison studies between the monitoring methods of the surface cleaning and disinfection process.²⁹ Studies comparing the methods of monitoring surface cleaning are necessary to indicate which methods are most likely to represent the real situation of the surfaces, that is, clean or dirty, and so we can have subsidies to choose the method (s) that best meets the reality of each service and unit.

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In another study²⁴, a cutoff point of 8URL/cm² for ATP was obtained in its results. In this study, the analysis of the ROC curve obtained a cutoff point of 48URL/cm², so it is observed that the samples were taken on surfaces of 10 cm x 10 cm in the first study, which corresponds to 100 cm². To standardize them with the CCA, which was 2.5 cm², they divided 800 URLs per 100 cm², which corresponded to 8URL/cm², well above 48URL/cm², being far below the 250 URLs, frequently used value as a parameter for cleaning classification of surfaces. It cannot be affirmed that the values found in this study are consistent in the literature and prove that the surfaces are clean or dirty.

One of the possible causes for the non-reduction of ATP in a medical ward was related to the team's lack of opportunity to perform extensive cleaning due to work overload²⁵. It is also corroborated that for the nursing team, patient care ends up being a higher priority when compared to the need to clean the environmental surfaces.¹⁷ During the period of data collection in the family health strategy, prioritization of assistance to the patient, because to carry out the cleaning process in the dressing and vaccine rooms, they need to interrupt the care to perform the L&D process of the surfaces.

It is important to highlight that all health services, regardless of the level of complexity, should adopt measures to prevent infections, looking for the provision of safe health care, although there is a precarious data about the real impact of infections in health service.³⁰ However, in the rooms of the health units, procedures are performed that corroborate a potential contamination of the environment.²⁷

This research presents as limitations the non-identification of the species and possible levels of resistance of the microorganisms found in the total colonies, as well as the choice of only one unit of family health strategy. Both limitations are strongly associated with financial limitations for the development of this study. There is also a small number of studies aimed at evaluating the cleaning of surfaces in non-hospital settings, hindering to compare the data.

CONCLUSION

The results show the presence of significant correlation between ATP quantification bioluminescence and microbial counts only for the patient's bed (P=0.001). The sensitivity of the ATP test in the aerobic microbial count in this investigation was superior to the sensitivity of the visual inspection test. The

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specificity of ATP Bioluminescence and visual method presented high percentages. The accuracy of the visual inspection was low, so it would not be the ideal test to evaluate the cleaning of surfaces, it is necessary to employ a quantitative test.

The development of new studies related to the evaluation of the L/D process of surfaces is relevant, especially in healthcare services outside hospital care to know and define acceptable L/D monitoring values in the primary care setting to the proper monitoring of the cleaning process.

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