FLUORESCENT MARKERS FOR CLEANING AND SURFACE DISINFECTION MONITORING

MARCADORES FLUORESCENTES PARA O MONITORAMENTO DA LIMPEZA E DESINFECÇÃO DE SUPERFÍCIES

MARCADORES FLUORESCENTES PARA EL MONITOREO DE LA LIMPIEZA Y DESINFECCIÓN DE SUPERFÍCIES

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ABSTRACT

Objective: to describe the use of fluorescent markers to monitor surface cleaning and disinfection. **Method:** this is a bibliographical study, type integrative review, carried out from LILACS, MEDLINE and the SciELO virtual library. Portuguese, English and Spanish articles were included, without delimitation of period. From the critical analysis of the abstracts, ten (100%) articles were selected. The results were presented in the form of figures. **Results:** four (40%) were published in the year 2008. It is noteworthy that seven (70%) have the objective of evaluating and improving cleaning practices in several environments. **Conclusion:** new studies are suggested that demonstrate the impact of cleaning interventions with the patient's safety indicators, allowing an accurate indication of the gains to the patient. **Descriptors:** Fluorescent dyes; Disinfection; Hospital Cleaning Service; Quality management; Nursing Audit; Equipment Contamination.

RESUMO

Objetivo: descrever o uso de marcadores fluorescentes para o monitoramento da limpeza e a desinfecção de superfícies. **Método:** trata-se de um estudo bibliográfico, tipo revisão integrativa, realizado a partir das bases de dados LILACS, MEDLINE e na biblioteca virtual SciELO. Incluíram-se artigos nas línguas portuguesa, inglesa e espanhola, sem delimitação de período. Selecionaram-se, a partir da análise crítica dos resumos, dez (100%) artigos. Apresentaram-se os resultados em forma de figuras. **Resultados:** relata-se, com relação à caracterização dos artigos analisados, que quatro (40%) foram publicados no ano de 2008. Nota-se que sete (70%) apresentam como objetivo avaliar e melhorar as práticas de limpeza em diversos ambientes. **Conclusão:** sugerem-se novos estudos que vislumbrem demonstrar o impacto de intervenções na limpeza com os indicadores de segurança do paciente, permitindo apontar exatamente os ganhos ao paciente. **Descritores:** Corantes Fluorescentes; Desinfecção; Serviço Hospitalar de Limpeza; Gestão da Qualidade; Auditoria de Enfermagem; Contaminação de Equipamentos.

RESUMEN

Objetivo: describir el uso de marcadores fluorescentes para el monitoreo de la limpieza y la desinfección de superficies. **Método:** se trata de un estudio bibliográfico, tipo revisión integrativa, realizado a partir de las bases de datos LILACS, MEDLINE y en la biblioteca virtual SciELO. Se incluyeron los artículos en portugués, Inglés y Español sin periodo de delimitación. Se seleccionaron, a partir del análisis crítico de los resúmenes, diez (100%) artículos. Se presentaron los resultados en forma de figuras. **Resultados:** se relata, con relación a la caracterización de los artículos analizados, que cuatro (40%) fueron publicados en el año 2008. Se nota que siete (70%) presentan como objetivo evaluar y mejorar las prácticas de limpieza en diversos ambientes. **Conclusión:** se sugieren nuevos estudios que vislumbre demostrar el impacto de intervenciones en la limpieza con los indicadores de seguridad del paciente, permitiendo apuntar exactamente las ganancias al paciente. **Descriptor:** Colorantes Fluorescentes; Desinfección; Servicio de Limpieza en Hospital; Gestión de la Calidad; Auditoria de Enfermería; Contaminación de Equipos.

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INTRODUCTION

It is known that the infections related to health care (IRHC) involve multifaceted aspects, causing interference to patients, family and professionals, as well as health services, since they increase the risk of death and hospitalization costs.¹⁻² It is estimated that in 2011, in the USA, there were 721,800 cases of IRHC,³ being one of the main causes of morbidity and mortality in the world. Strategies are required for its intervention, ranging from adherence to hand hygiene practices to antimicrobial control and cleaning and disinfection (L & D) of the environment.⁴

It should be noted that the contaminated environment plays a significant role in the spread of micro-organisms, including multiresistant pathogens, such as methicillin-resistant *Staphylococcus aureus* (MRSA), among others.⁵⁻⁷ It should be noted that surfaces considered to have a high frequency of touch, such as door handles, cables and switches, should pay special attention,⁸ in addition to other surfaces that are close to the patient, for example: bed frame, headboards, pump of infusion, among others, that are in frequent contact with the hands of patients and/or professionals, functioning as a reservoir of microorganisms.⁹

It should be emphasized that actions aimed at strengthening hand hygiene practice have contributed to the prevention of IRHC, however, the permanent adherence of professionals and patients to this practice is still a challenge to health services.⁸ In this context, it is based on adherence to a satisfactory cleaning in the environments, for the reduction of pathogens, thus strengthening patient safety.⁵

Several methods of L & D monitoring are identified in the literature, the most used being: visual inspection, total colon count, ATP (Adenosine Triphosphate) quantification and the use of fluorescent markers.⁷ The use of environmental markers is to apply a fluorescent dye (practically invisible to the naked eye) on the surface prior to the L&D process, and after the L&D is performed, with the aid of a black light, has been completely removed from the surface or if residues of the latter.¹⁰⁻¹¹

It is added that, although among the L & D monitoring methods, the most used by health services is still visual inspection, mainly because of its low cost, it still presents itself as a subjective indicator of cleanliness.¹² It is therefore pertinent to point out that all monitoring methods have advantages and disadvantages.

OBJECTIVE

- Describe the use of fluorescent markers for the monitoring of surface cleaning and disinfection.

METHOD

This is a quantitative, bibliographical study, type integrative review with the purpose of answering the following guiding question: "What are the indicatives and the limitations in the use of fluorescent dyes for the evaluation of the process of cleaning surfaces in health services? ".

In this perspective, the following paths were used to meet the study objective: the establishment of the hypothesis and the objectives of the integrative review; the determination of criteria for inclusion and exclusion of articles (sample selection); the definition of the information to be extracted from the selected articles; analysis of results; discussion and presentation of results and review.¹³

The research was carried out in November 2017, being MEDLINE via PubMed, LILACS (Latin American and Caribbean Literature in Health Sciences) and SciELO (Scientific Electronic Library Online) virtual library. The available descriptors DeCS / MeSH: "fluorescent dyes" were used; "Fluorescent dyes"; "disinfection"; "Disinfection", "hospital cleaning service" and "hospital housekeeping", combined through the Boolean operator AND.

As search strategies for the selection of articles, were used: (in PubMed / MEDLINE) fluorescent dyes AND disinfection, fluorescent dyes AND hospital housekeeping, disinfection AND hospital housekeeping; (in LILACS and SciELO) fluorescent dyes AND disinfection, fluorescent dyes AND hospital cleaning service, disinfection AND hospital cleaning service.

Portuguese, English and Spanish articles were included, which included the use of fluorescent dyes as a method of monitoring surface cleaning in health services, without period delimitation. Duplicate periodicals were excluded. A form was developed in order to facilitate the analysis and characterization of the articles in the sample. The following information was presented in the form used: article identification and authors; location source; goals; delineation and synthesis of results.

A floating reading of the transcribed material was performed for the data treatment. Then, the clipping, aggregation and enumeration of the data were performed,

allowing evidence to be shown. For the information contained in the articles, the core of the analysis was formed, allowing the comparison of data from the literature.¹⁴

From the critical analysis of the abstracts, ten (100%) papers that met the proposed selection criteria were selected. The results of the searches with the crossings of the descriptors (Figure 1).

Figure 1. Flowchart for the selection of studies. Coxim (MS), Brazil, 2017.

For the definition of the level of evidence, the validated criteria were chosen¹⁵, being: I - systematic reviews or meta-analysis; II - randomized, controlled study; III - controlled clinical trial without randomization; IV - case-control or cohort; V - systematic review of qualitative or descriptive studies; VI - qualitative or descriptive study; VII - expert opinion or consensus.

The data was categorized using Content Analysis as a method, seeking to group the information in a clear and objective way, in order to strengthen confidence in the results found ¹³. The studies were grouped in four thematic categories with the purpose of facilitating the categorization of the data in the articles: I - Interventions and feedback for the team; II - Products for cleaning and

disinfection; III - Monitoring methods; IV - Diagnosis of surface L&D.

RESULTAS

It was observed, in relation to the characterization of the articles analyzed, that the majority, four (40%), was published in 2008, and the others were published: three (30%) in 2013, one (10%) in 2014 , one (10%) in 2011 and one (10%) in 2006.

It was found from the journals that four (40%) studies were published in the journal Infect Control Hosp Epidemiol; two (20%) in the Journal of Hospital Intection; two (20%) in the American Journal of Infection Control; one (10%) in BMC Infectious Diseases, and one (10%) in Can J Infect Control.

It is inferred that the majority of the articles are of a quantitative approach, four (40%), followed by two (20%) quantitative and comparative, two (20%) intervention studies, one (10%) and one (10%) prospective intervention.

Most of the articles, seven (70%), had as objective: to evaluate and improve cleaning practices in different environments; one (10%) seeks to evaluate the efficacy of surface disinfectants; one (10%) is aimed at testing the hypothesis that the fluorescent marker or ATP-based monitoring systems are better than isolated visual inspection and one (10%) seeks to compare the use of fluorescent markers with counts of aerobic colonies (ACC's) and an adenosine triphosphate (ATP) bioluminescence

assay system to analyze terminal cleaning practices.

Most of the studies were classified in category IV (Diagnosis of L&D), with 40% of the studies (articles 5,6,8,9); then the category I (Interventions and feedback to the team), with 30% of the researches (articles 2,4,7); Category III (Monitoring methods, with 20% of the studies (Articles 3 and 9) and, finally, Category II (Evaluation of products), with only 10% of the studies (Article 1).

A synoptic chart was constructed (Figure 2), seeking to facilitate the visualization of the results. The titles of the articles, the periodicals and the year of publication, the outline of the research, the objectives and the level of evidence can be seen.

Study	Article title	Journal and year of publication	Research outline	Objective	Level of evidence
01	Evaluating a new paradigm for comparing surface disinfection in clinical practice	Infect Control Hosp Epidemiol. 2014	Quantitative and comparative	Evaluate, in two phases, the clinical efficacy of two surface disinfectants.	VI
02	Continuing performance feedback and use of the ultraviolet visible marker to assess cleaning compliance in the healthcare environment	J Hosp Infect. 2013	Intervention	Evaluate the effect of providing weekly feedback to the cleaning staff on improving and maintaining compliance with cleanliness by using the visible ultraviolet marker as an audit tool.	IV
03	Diagnostic assessment of different environmental cleaning monitoring methods	Am J Infect Control. 2013	Prospective	To test the hypothesis that fluorescent marker systems and evaluation by adenosine triphosphate (ATP) are better than visual evaluation.	IV
04	Improving cleaning of the environment surrounding patients in 36 acute care hospitals	Infect Control Hosp Epidemiol. 2008	Prospective and of intervention	Thoroughly evaluate the cleanliness of the terminal room before and after structured educational and procedural interventions.	IV
05	UV-visible marker confirms that environmental persistence of Clostridium difficile spores in toilets of patients with C. difficile -associated diarrhea is associated with lack of compliance with cleaning protocol.e.	BMC Infectious Diseases. 2008	Quantitative	Evaluate the cleanliness compliance of the staff to restrooms in a tertiary health setting.	VI

06	Intensive care unit environmental cleaning: an evaluation in sixteen hospitals using a novel assessment tool	J Hosp Infect. 2008	Quantitative	Evaluate and improve current cleaning practices.	VI
07	An environmental disinfection odyssey: evaluation of sequential interventions to improve disinfection of Clostridium difficile isolation rooms	Infect Control Hosp Epidemiol. 2013	Intervention	Evaluate the cleanliness compliance of the cleaning staff for restrooms in a tertiary health setting.	IV
08	An evaluation of patient area cleaning in 3 hospitals using a novel targeting methodology	Infect Control Hosp Epidemiol. 2006	Quantitative	Evaluate the thoroughness of the patient area cleanliness.	VI
09	Comparison of fluorescent marker systems with 2 quantitative methods of assessing terminal cleaning practices	Infect Control Hosp Epidemiol. 2011	Quantitative and comparative	Compare fluorescent markers with counts of aerobic colonies and bioluminescence systems to evaluate cleaning practices.	VI
10	Use of a fluorescent chemical as a quality indicator for a hospital cleaning program	Can J Infect Control. 2008	Quantitative	Evaluate daily cleaning using a fluorescent chemical powder.	VI

Figure 2. Scientific production about the monitoring process. Coxim (MS), Brazil, 2017.

DISCUSSION

It was verified, according to the results found, that, in relation to the year of publication of the articles, 100% of the studies concentrated in the period from 2006 to 2014, with a predominance of international journals. Recently, ANVISA¹⁶ published a guidebook for health services L & D, which cites some monitoring methods.¹⁷

It was observed, in relation to the study sites, that the hospital context was the main research scenario, however, it is pertinent to point out, as pointed out in the study,¹⁸ that in primary care, invasive procedures are also developed. It is believed, therefore, that environmental surfaces can also harbor microorganisms, which requires adequate attention in L&D processes, with the perspective of minimizing the occurrence of IRHC.

It was found, as far as the periodicals in which the studies were published, that most of the articles fell within category IV (Cleaning and disinfection diagnosis). It can be seen, according to a review study,¹³ that the fluorescent marker systems present, as an advantage, their low cost, the low need for equipment and their ability to evaluate practices, that is: they are a cheap audit tool

, which allows to evaluate the cleaning done.¹⁹ However, in the same review, this method presents, as a disadvantage, the need to fix the marker on the surface, before the team performs the cleaning, and later to verify that the marker has been removed, and that fact requires that this action be carried out in a confidential manner in relation to the L&D team.

It has been shown, in review,¹⁰ that fluorescent gel systems should be used with other monitoring methods, such as cultures of microorganisms, in view of which the markers only allow to verify the practice of the cleaning, that is, if the gel was removed from the surface, not actually identifying whether the surface is adequately clean (free of pathogens or organic matter, for example).²⁰ It should be noted, however, that for the assertive removal of microorganisms and residual organic matter, friction is of paramount importance.¹⁹

In terms of category I (Interventions and feedback to the team), the need to extend ongoing education actions with the team is indicated, providing immediate feedback, with concrete results obtained through monitoring methods, for example, markers.²¹ It is understood that the development of educational interventions, feedback and

monitoring have allowed to improve the thoroughness of surface cleaning in several studies.^{19,22-3}

In a controlled study conducted at a Chinese intensive care unit for 13 months, team feedback, coupled with the use of the methods, for example the fluorescent marker and ATP, has been shown to provide a significant improvement in decontamination environment, even in relation to multiresistant microorganisms.⁵ This perspective is corroborated by the conclusion of a prospective study carried out in a hospital in which the authors stated that the choice of surface fluorescent dye and the use of the ATP method presented a better diagnosis of the quality of the L&D process performed.²⁴

However, it is demonstrated, as described in a review study,²⁰ that some substances that make up the markers can be seen in a small degree when placed on dark surfaces, and this aspect can corroborate the Hawthorne effect. It is believed that cleaning workers should ideally change their practices by focusing not only on the removal of the marker but on the effective improvement of all cleaning processes. It is therefore recommended that the marker be placed as widely as possible on the surfaces.

It is clear from Category III (Monitoring Methods) that all monitoring methods have advantages and disadvantages, and visual inspection, although it is the cheapest, does not provide an accurate assessment of L&D. The microbiological identification is allowed by the analysis of colony-forming units, but these require 48 to 72 hours for the data to be supplied. It is quantified by the use of ATP the presence of organic matter on the surface with immediate feedback, however, this requires investment in the acquisition of equipment and swabs.¹²

In another study evaluating L&D on surfaces of three hospitals, using fluorescent markers in 1404 high-touch locations, the choice of marking surfaces with target compounds is an excellent strategy to evaluate, in a more objective, the activity of L&D.⁸ However, due to the choice of monitoring method, the characteristics and specificities of each service should be considered, since, in cases of outbreaks, the choice of only fluorescent markers as a monitoring method is not a recommended action, since this method does not allow identification of the presence or absence of pathogens, but only indicates that a substance has been physically removed from a surface.²⁰

It was found, in conclusion of study,²⁴ that fluorescent markers allow better evaluation

compared to the exclusive use of the method of visual inspection used alone. However, in a study comparing fluorescent markers with aerobic colony count and ATP system, the markers allow to identify if the surface was cleaned, however, surfaces that were considered clean by the fluorescent marker criteria were less likely to be considered as clean when assessed by ACC and ATP tests.

In the case of category II (Product evaluation), in a study²⁵ where fluorescent markers were used to evaluate the clinical efficiency of the use of two surface disinfectants, the possibility of comparing two interventions at the same time, both at the same time which relates to the effectiveness of the product, regarding the cleaning process carried out. With the provision of new technologies to monitor cleaning and disinfection, the interest in evaluating cleaning and disinfection practices is high, and cleaning the environment is a relevant strategy for the prevention of IRHC.⁴

It is imperative, for a process of assertive cleaning and disinfection; to adopt protocols that are objectively elaborated and implemented through training with the team.¹ Fluorescent markers are presented as tools for evaluating protocols. control of infection, allowing to evaluate deficiencies in the standardization of practices and the effect of educational interventions with the team.¹¹ It can be seen that cleaning monitoring provides more concrete data about the actual situation of hygienic cleaning, favoring a global and uniform standardization of the evaluation, an education to the team in accordance with the evaluations. It also confirms the identification of opportunities for improvement, enhancing patient safety.¹⁰

The prevalence of intervention studies of a quantitative nature is evidenced in relation to the level of evidence, showing a deficit of comparative studies with the association between cleaning efficiency and IRHC indicators. This data is similar to that pointed out in a systematic review,⁴ where there was an enormous limitation of clinical studies that correlate the infection rates with the cleaning processes.

It should be noted that visual inspection is the most used method to evaluate cleanliness, since approximately 89% of a sample of hospitals in the United States are evaluated by this method. However, it is noted that this visual evaluation is subjective and fragile, allowing to identify gross flaws in cleaning. It is therefore urgent to thoroughly evaluate the cleaning process, since the literature already indicates that the risk is higher to obtain an

IRHC when occupying rooms previously contaminated by microorganisms of epidemiological relevance.^{10,19}

CONCLUSION

The results of this study show the predominance of studies of a qualitative nature, demonstrating the lack of comparative studies. It has been found in several studies that visual inspection is a fragile indicator to describe exactly how surfaces are cleaned or not, and fluorescent markers have been presented as more objective strategies to identify the effectiveness of the cleaning practice and provide a feedback to the team.

Another relevant result is the scarcity of recent studies that used fluorescent markers, mainly national publications and in non-hospital contexts.

It is therefore relevant to develop new research in other health services in addition to hospitals, seeking to strengthen scientific progress. There is also a need to demonstrate the impact of interventions in cleaning and disinfecting surfaces with patient safety indicators, allowing an accurate indication of the gains to patients.

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