Revista Prevenção de Infecção e Saúde
The Official Journal of the Human Exposome and Infectious Diseases Network

ORIGINAL ARTICLE DOI: https://doi.org/10.26694/repis.v6i0.10364

Contamination of X-ray equipment in the context of the pandemic of COVID-19

Contaminação de equipamentos de raios x no contexto da pandemia de COVID-19

Contaminación de equipo de rayos X en el contexto de la pandemia de COVID-19

Lucas Daniel Siqueira [1], **Priscilla Dantas Almeida** [1,2]

How to cite this article:
Siqueira LD, Almeida PD. Contamination of X-ray equipment in the context of the pandemic of COVID-19. Rev Pre Infec e Saúde [Internet]. 2020;6:10364. Available from: http://www.ojs.ufpi.br/index.php/nupcis/article/view/10364 DOI: https://doi.org/10.26694/repis.v6i0.10364

[1] Federal Institute of Education, Science and Technology of Piauí, Central Campus, Department of Information, Environment, Health and Food Production, Radiology Technology Course, Teresina, Piauí, Brazil.

[2] Federal University of Piauí, Nursing Department, Teresina, Piauí, Brazil.

ABSTRACT

Introduction: Due to high patient turnover in radiology department, the risk of disease transmission is verified, and COVID-19 is the main challenge currently. Considering this, this study aims to investigate the evidence on contamination of radiological equipment and actions for infection control. **Outline**: It is an integrative review study developed from the analysis of scientific productions published in Latin America and Caribbean Health Sciences Literature (LILACS), PubMed and ScienceDirect databases. These were accessed between March 16 and April 8, 2020. **Results**: The studies identified presence of pathogenic microorganisms on X-ray equipment. The main recommendations were: use of personal protective equipment by professionals, routine disinfection of equipment of the department and implementation of protocols and training on surface cleaning. It is worth noting the hospital screening and route strategy for the patient suspect of COVID-19 without contacting others. **Implications**: Managers and professionals should implement actions as those highlighted in the studies, for example, the display of posters in the department to advise patients and clarify the characteristics of the disease for the population.

DESCRIPTORS

Infection Control; Radiology; Equipment Contamination; Coronavirus.

Corresponding author:
Priscilla Dantas Almeida
Address: Campus Universitário Ministro Petrônio Portella, Ininga
CEP 64049-550 – Teresina, Piaui, Brazil
Telephone: + 55 (86) 3215-552
E-mail: priscilladant@hotmail.com

Submitted: 2020-04-10
Accepted: 2020-04-14
Published: 2020-06-01

INTRODUCTION

Daily, in a hospital unit, various methods of examinations for obtaining diagnoses, particularly, in radiology department. The generated images are of great importance to make reports and follow-ups of patients who suffer from several pathologies. Due to the high turnover of medical care in this department, from checkup to urgent cases and hospitalization on-site, the risk of disease transmission is, especially, observed.[1]

This way, the hospital environment provides, for patients, latent risk of disease and infection transmission, in addition to being source of recovery of some high resistant microorganisms. So, in hospital environment, there are a great number of bacteria and viruses, as well as several other types of microorganisms. In this sense, there is the need to sanitize and clean the radiology department frequently.[2]

With the emergence of the COVID-19 pandemic in 2019, in China, various hospitals and staffs had their routines changed by the virus. The high risk of transmission caused the use of extreme protection measures among professionals because it is a transmission by aerosol and contact as coronavirus spreads easily in the air. In this context, the use of protective equipment, such as N95 mask, acrylic glasses, surgical clothing, surgical caps, sterile gloves, among others.[3]

Given that, radiology professionals are not exempt from risk of virus transmission. Those who perform radiography and computed tomography (CT) examinations are at greater risk of contagion. Therefore, in addition to professional's protection, it is necessary that the patient with suspected contagion is adequately protected so that, during a coughing episode, there is no virus propagation for the environment. The examination table of CT should be protected in order to prevent the direct contact between patient and equipment, and its cleaning is necessary, at the end of examination, alternately using a disinfectant substance of chlorine and ethanol at 70% concentration.[3]

It is important to note that CT is considered one of the best imaging methods since it enables the accurate monitoring of various pathologies, and the tomography of the chest deserves an additional value by its contribution to diagnosis and/or in evolution of lung diseases, such as the COVID-19. However, it is noteworthy that CT of the chest alone is not enough to confirm or exclude the diagnosis of infection by the novel coronavirus.[4]

In the face of this, describing the context of professionals' actions of radiological techniques for hygiene care against pathogens, such as the SARS-2 coronavirus, becomes relevant and necessary, as source of research for the development of new studies on the aspects pointed out.

Therefore, the present study aims to investigate, through a literature review, the evidence on contamination of radiological equipment and actions for infection control.

METHOD

It is an integrative review study, as this type of study aims to synthetize the results achieved from a research on a particular topic or issue, providing information about a problem and building, thus, a body of knowledge.[5]

The study was developed from the survey and analysis of scientific productions published in April 2020 in the following databases: Latin America and Caribbean Health Sciences Literature (LILACS) via Virtual Health Library (VHL), PubMed and ScienceDirect.

The studies were selected from the application of keywords in English, Spanish and Portuguese, with Boolean operators in the following equations: "infection control and equipment contamination and radiology" (first equation), "infection control and radiology" (second equation) and "equipment contamination and radiology". The databases were

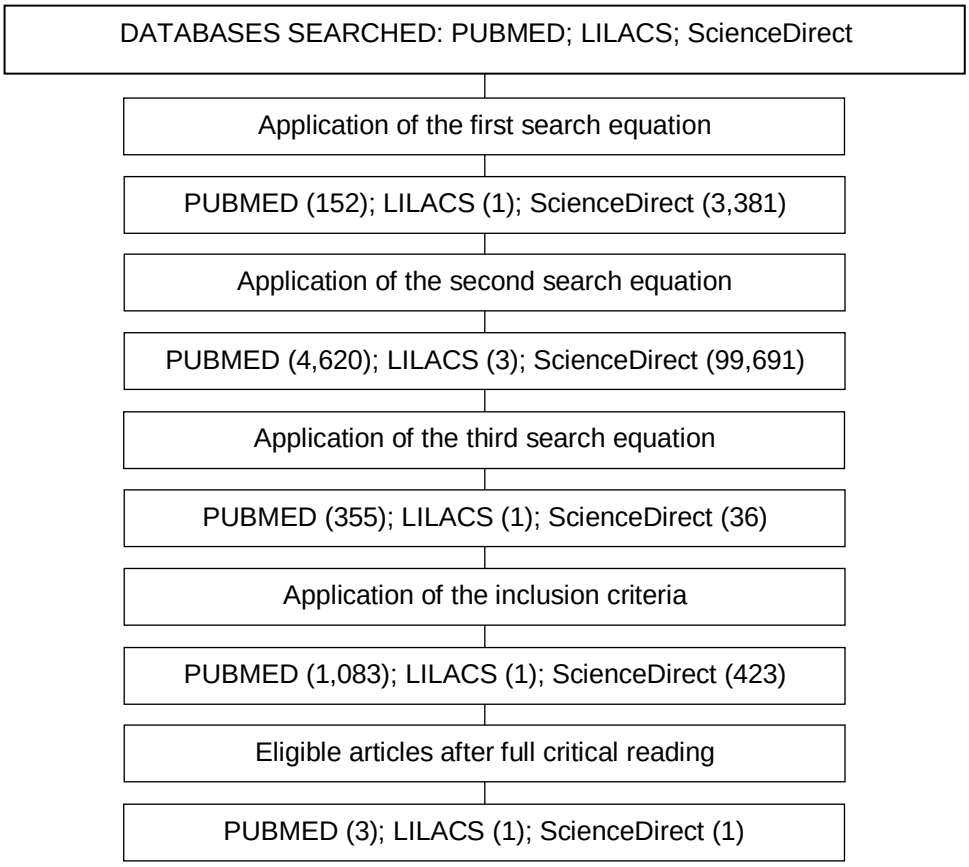
accessed in the period of March 16 to April 8, 2020, by two researchers at the same time.

We sought to answer the following guiding question: in what scientific context are infection control and X-ray equipment? So, the review used the strategy of identification of Problem, Variable of Interest and Outcome (PVO), according to adaptation.[6] The following were considered as inclusion criteria: studies published in the last ten years (from 2010 to 2020), available in full and written in Portuguese, English or Spanish language. As exclusion criteria, those that did not match the study subject were not considered.

To perform the searches and data collections, the first search equation was applied, next, the other equations. Subsequently, the results were filtered, meeting the inclusion criteria. After that, reading of titles and abstracts of preselected studies were performed and, in sequence, the reading in full and judiciously of elected articles was done. Finally, a flowchart was elaborated to illustrate the steps of selection of articles included in this study (Figure 1).

After organizing the results in a sample definition table used in this study, important aspects of selected works were identified, they are: authors and year of publication; objective of the study; outline; results and implications; and limitations. With the results of searches analyzed, the discussion was elaborated through reflection of its relationship with other scientific references.

Figure 1 – Selection flow of articles for the study. Teresina, PI. 2020.



Source: Authors themselves.

RESULTS

The results were organized and elaborated after the analysis of studies that were elected for this study, according to the application of the search equations, inclusion criteria and those related to the study topic. A single study addressed the transmission by COVID-19. In it, it is worth mentioning that, with the implementation of specific care, the results were satisfactory, such as non-transmission of the disease by health professionals (Chart 1).

Chart 1 – Characteristics of studies on contamination of X-ray equipment.

Reference	Objective	Outline	Results and implications	Limitations
Fauci et al. 2016[7]	To examine the use and maintenance of protective lead garments, assessing, particularly, its microbiological contamination and its practical use by health professionals during surgical procedures.	Cross-sectional study performed in three stages, in seven surgical departments at a hospital. The first one, with the administration of a questionnaire for coordinators of departments, the second one, from the classification of garments by type, and the third stage was the analysis of microorganisms by swab collection.	The study showed that only 66.7% of garments are sanitized and that there was presence of bacterial contamination on 88 items. Potentially dangerous pathogenic strains were identified. So, it was verified that, for the proper conservation and reduction of contamination, it is necessary to sanitize and store the used garments properly, as well as continuing training and supervising operating room procedures.	Non-blinding of participants
Malta et al. 2016[8]	To assess the contamination rate of intra- and extraoral digital radiography equipment in a dental radiology clinic at a public educational institution.	Cross-sectional study performed in three non-consecutive days in a radiology department. Laboratory analysis of microorganisms present on equipment was performed.	Fungi and staphylococci growth were observed on all sampling sites. In general, the need to establish stricter infection control protocols in radiology practice to prevent cross-contamination was identified.	Non-blinding of participants
Giacometti et al. 2014[9]	To examine the level of microbiological contamination in the main radiology departments in Turin, to analyze the presence of a possible biological risk.	Cross-sectional study performed from collection of materials from X-ray tubes, control panels, cassettes and imaging plates in 12 radiology departments. Results were related to the results obtained with the French standard NF S 90-351 to obtain the threshold values of reference. Next, questionnaires with managers of radiology departments were administrated.	Values out of limits were verified in 41.7% of the X-ray tubes sampled, in 91.7% of the control panels and imaging plates, while only 8% of the radiographic cassettes were contaminated. A total of 58.3% of radiology departments reported values above the threshold for three out of four samples. The study highlighted the need for further investigations with monitoring of the microbial species present, in addition to the development of official standards for the assessment of microbiological contamination in radiology departments.	Non-blinding of participants
Kim J-S et al. 2012[10]	To assess contamination with methicillin-resistant *Staphylococcus aureus* (MRSA) and methicillin-resistant *Staphylococcus haemolyticus* (MRSH) on X-ray cassettes.	Cross-sectional study with laboratory analysis of 37 cassettes in an X-ray department.	It showed that X-ray cassettes that are in contact with patient were contaminated with MRSA and MRSH, and those are considered sources of transmission of pathogens. So, the application of contamination barriers or regular decontamination procedures are indicated.	Absence of control group
Huang et al. 2020[11]	To describe the strategy and the emergency management and infection control procedure in a radiology department during the coronavirus disease 2019 (COVID-19) outbreak.	Observational study with the strategy description in the radiology department at a hospital.	It was verified that the measures taken had satisfactory results, they are: provision of personal protective equipment, setting up tents for screening of patients who had fever, planning of the examination route and isolation for suspected cases of COVID-19.	Absence of control group

DISCUSSION

In health care practice, the strategies with the best results should be recognized and implemented. Moreover, confirming the presence of pathogens on surfaces is of great importance to provide qualified care for patient. Most of the examinations performed

in a radiography room do not involve secretions or contaminating materials, because of this, many professionals, be it technician or technologist, do not consider the hygiene of table Bucky and wall Bucky or other accessories. Study performed in the radiology department concluded that the lack of care for decontamination persisted even with the previous presence of the research team; thus, there were no positive results in reducing microorganisms or staff awareness.[12]

Various diseases acquired by patients are considered uncommon in certain regions. Travel, mainly air travel between countries, is often the motive of virus infection outbreaks, such as Ebola, in Africa in 2014, H1N1, in 2009, and, more recently, COVID-19. Frequently, the use of radiodiagnostic examinations as complementary method for diagnosis of these diseases is common; thus, it should be noted the importance of equipment decontamination as important measure. Therefore, strategic care for avoiding contact with other professionals, as observed in some studies elected in this study, is fundamental to the control of some diseases.[13]

As the Ebola case, the virus can endure alive for several days on dry surfaces, which had contact with patient's secretions. Commonly, because of unspecific symptoms, patients are referred to the radiology department to perform examinations; however, caution is needed due to the difficult in finding radiographic traces in the first 72 hours after the onset of symptoms, and the use of portable radiology and ultrasound devices is more advisable, after patient admission, since the patient referral to radiographic, tomographic and magnetic resonance examination rooms poses a greater risk of disease spread.[13]

SARS-CoV-2, popularly known as coronavirus, is primarily responsible for, since December 2019, in China, a proliferation condition considered, currently, as a global pandemic due to uncontrolled spread of the virus among humans through airway, and it can lead to pneumonia and, in more severe cases, Severe Acute Respiratory Syndrome (SARS) conditions.[14]

Computed Tomography of the chest is one of the preferred examinations for monitoring of diagnosis of COVID-19 condition, as its result is rapid. In case of suspected coronavirus infection, patient isolation is authorized by the radiologist. When there is no confirmation by laboratory examination, the high-resolution images generated by the equipment help in diagnostic result.[14]

Considering that, the control room and the examination room must be cleaned and disinfected constantly. Because it is a highly transmissible disease, its spread must be fight to the maximum by the health staff. Thus, the surface cleaning must be done several times a day, using an exhaust fan, within three hours between examinations for the safety of the next patients.[3]

The present study had as limitation the reduced number of original publications, especially on COVID-19. It is important to note, also, that studies with analysis of microorganisms present on equipment surfaces in radiology department were more common.

CONCLUSION

In view of what was discussed, the studies analyzed showed work strategies and punctual analyses of how to keep the care for and prevention of infections and contamination in health service, emphasizing the recent public health problem faced worldwide, the COVID-19 pandemic. In addition to the approach to novel coronavirus, the analysis of scientific production allowed us to identify that equipment and surfaces are contaminated in radiology department, as, in this place, collections and subsequent laboratory analyses are performed. So, the constant improvement of health professionals, highlighting radiology technician and technologist, becomes important on hygiene and other preventive care in radiology department.

RESUMO

Introdução: Devido à alta rotatividade de pacientes no setor de radiologia, verifica-se o risco de transmissão de doenças, sendo a COVID-19 o principal desafio da atualidade. Em vista disso, este estudo tem como objetivo investigar as evidências sobre a contaminação de equipamentos radiológicos e ações para o controle de infecções. **Delineamento:** Trata-se de um estudo de revisão integrativa desenvolvido a partir da análise das produções científicas publicadas nas bases de dados Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS), PubMed e ScienceDirect. As bases foram consultadas entre 16 de março e 8 de abril de 2020. **Resultados:** Os estudos identificaram a presença de microrganismos patógenos em equipamentos de raios X. As recomendações principais foram: uso de equipamentos de proteção individual pelos profissionais, desinfecção rotineira dos equipamentos do setor e implantação de protocolos e treinamento sobre a higienização de superfícies. Destacou-se a estratégia de triagem e percurso para o paciente suspeito de COVID-19 pelo hospital sem contato com os demais. **Implicações:** Os gestores e os profissionais devem implementar ações como as destacadas nos estudos, por exemplo, a disposição de cartazes pelo setor com as funções de orientar os pacientes e esclarecer a população acerca das características da doença.

DESCRITORES

Controle de infecção; Radiologia; Contaminação de Equipamentos; Coronavirus.

RESUMEN

Introducción: Debido a la alta rotación de pacientes en el sector de radiología, existe el riesgo de transmisión de la enfermedad, con COVID-19 siendo el principal desafío en la actualidad. En vista de esto, este estudio tiene como objetivo investigar la evidencia sobre la contaminación del equipo radiológico y las acciones para el control de infecciones. **Delineación:** Este es un estudio de revisión integradora desarrollado a partir del análisis de publicaciones científicas publicadas en las bases de datos de Literatura en Ciencias de la Salud de América Latina y el Caribe (LILACS), PubMed y ScienceDirect. Las bases fueron consultadas entre el 16 de marzo y el 8 de abril de 2020. **Resultados:** Los estudios identificaron la presencia de microorganismos patógenos en equipo de rayos X. Las principales recomendaciones fueron: uso de equipo de protección personal por parte de profesionales, desinfección rutinaria de equipos en el sector e implementación de protocolos y capacitación en limpieza de superficies. Se destacó la estrategia de detección y la ruta del paciente sospechoso de COVID-19 a través del hospital sin contacto con los demás. **Implicaciones:** Los gerentes y profesionales deben implementar acciones como las destacadas en los estudios, por ejemplo, la provisión de carteles por el sector con las funciones de guiar a los pacientes y aclarar a la población sobre las características de la enfermedad.

DESCRIPTORES

Control de Infecciones; Radiología; Contaminación de Equipos; Coronavirus.

REFERENCES

1. Almeida MWM, Lembo T. Microbiota residente em equipamentos de radiodiagnóstico e a importância em reduzir a disseminação de microrganismos nas instituições de saúde. J Health Sci Insto on line [Internet]. 2015 Jan [cited 25 Mar 2020]; 33(4):309–13t. Available from: https://www.unip.br/presencial/comunicacao/publicacoes/ics/edicoes/2015/04_out-dez/V33_n4_2015_p309a313.pdf

2. Pereira LM, Madeira MZA, Silva FJG Jr, Deolindo VS, Trabasso P. Contaminação de cassetes radiográficos em hospital privado: uma contribuição da enfermagem. J Health Sci Inst on line [Internet]. 2012 Feb [cited 25 Mar 2020]; 30(3):249–54. Available from: https://www.unip.br/presencial/comunicacao/publicacoes/ics/edicoes/2012/03_jul-set/V30_n3_2012_p249a254.pdf

3. An P, Ye Y, Chen M, Chen Y, Fan W, Wang Y. Management strategy of novel coronavirus (COVID-19) pneumonia in the radiology department: a Chinese experience. Diagn Interv Radio [Internet]. 2020 Mar [cited 25 Mar 2020]. Available from: https://doi.org/10.5152/dir.2020.20167

4. Chate RC, Fonseca EKUN, Passos RBD, Teles GBS, Shoji H, Szarf G. Apresentação tomográfica da infecção pulmonar na COVID-19: experiência brasileira inicial. J bras pneumol [Internet]. 2020 Apr [cited 25 Mar 2020]; 46(2):1–4. Available from: https://doi.org/10.36416/1806-3756/e20200121

5. Ercole FF, Melo LS, Alcoforado CLGC. Revisão Integrativa versus Revisão Sistemática. REME. 2014 Jan [cited 25 Mar 2020]; 18(1):1–260. Available from: http://www.dx.doi.org/10.5935/1415-2762.20140001

6. Biruel E, Pinto R. Bibliotecário, um profissional a serviço da pesquisa. In: XXIV Congresso Brasileiro de Biblioteconomia, Documentação e Ciência da Informação. [Anais]... Maceió: CBBD; 2011. Available from: https://www.academia.edu/9594560/Bibliotec%C3%A1rio_um_profissional_a_servi%C3%A7o_da_pesquisa

7. Fauci Vla, Riso R, Facciolà A, Merlina V, Squeri R. Surveillance of microbiological contamination and correct use of protective lead garments. Ann Ig [Internet]. 2016 Sep [cited 25 Mar 2020]; 28:360–366. Available from: http://www.dx.doi.org/10.7416/ai.2016.2116

8. Malta CP, Damasceno NNL, Ribeiro RA, Silva CSF, Devito KL. Microbiological Contamination in Digital Radiography: Evaluation at the Radiology Clinic of an Educational Instituition. Acta Odontol Latinoam [Internet]. 2016 Feb [cited 25 Mar 2020]; 27(29):239–247. Available from: https://pdfs.semanticscholar.org/e519/ad51d8d5d4cd4771a4e0acc57b6b90eab0b6.pdf
9. Giacometti M, Gualano MR, Bert F, Minnite D, Bistrot F, Grosso M, et al. Microbiological contamination of radiological equipment. Acta Radiol [Internet]. 2014 Nov [cited 25 Mar 2020]; 55(9):1099–103. Available from: http://www.dx.doi.org/10.1177/0284185113512481

10. Kim J-S, Kim H-S, Park J-Y, Koo H-S, Choi C-S, Song W, et al. Contamination of X-ray Cassettes with Methicillin- resistant Staphylococcus aureus and Methicillin-resistant Staphylococcus haemolyticus in a Radiology Department. Ann Lab Med [Internet]. 2012 May [cited 25 Mar 2020]; 32(3):206–9. Available from: http://www.dx.doi.org/10.3343/alm.2012.32.3.206

11. Huang Z, Zhao S, Li Z, Chen W, Zhao L, Deng L, et al. The Battle Against Coronavirus Disease 2019(COVID-19): Emergency Management and Infection control in a Radiology Department. J Am Coll Radiol [Internet]. 2020 Mar [cited 25 Mar 2020]; 1546–1440(20):30285-4. Available from: https://doi.org/10.1016/j.jacr.2020.03.011

12. Harvin A, VanMiddlesworth K, Botstein J, Hazelrigg R, Hill J, Thacker P. Addressing Bacterial Surface Contamination in Radiology Work Spaces. J Am Coll Radiol [Internet]. 2016 Oct [cited 25 Mar 2020]; 3(10):1271–1275. Available from: https://doi.org/10.1016/j.jacr.2016.03.022

13. Mollura DJ, Palmore DN, Folio LR, Bluemke DA. Radiology Preparedness in Ebola Virus Disease: Guidelines and Challenges for Disinfection of Medical Imaging Equipment for the Protection of Staff and Patients. Radiology [Internet]. 2015 May [cited 25 Mar 2020]; 275(2): 538–544. Available from: https://doi.org/10.1148/radiol.15142670

14. Li Y, Xia L. Coronavirus Disease 2019 (COVID-19): Role of Chest CT in Diagnosis and Management. AJR Am J Roentgenol [Internet]. 2020 Mar [cited 25 Mar 2020]; 1–7. Available from: https://doi.org/10.2214/AJR.20.22954

COLLABORATIONS

LDS: contributions since the elaboration of scientific project as well as to writing the article to submit to the journal; PDA: substantial contributions to data analysis and to interpretation of studies to make the study and critical review of the article. All the authors agree and take responsibility for the content of this manuscript version to be published.

ACKNOWLEDGMENTS

Does not apply.

AVAILABILITY OF DATA

Does not apply.

FUDING SOURCE

Does not apply.

CONFLICTS OF INTEREST

There are no conflicts of interest to declare.