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Ants associated with pathogenic microorganisms in brazilian hospitals: attention to a silent vector

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ABSTRACT. The presence of ants in hospitals is a threat to the health of the hospital community, given the potential to carry pathogenic microorganisms. This study was developed in order to comment on publications related to the occurrence of ants associated with pathogenic microorganisms in hospitals in Brazil. Studies indicated that ants were collected in several wards of 13 hospitals in five States from South and Southeast regions. The microbiological analysis has identified on the ants, microorganisms such as *Staphylococcus, Streptococcus, Klebsiella, Escherichia coli, Pseudomonas*, and others with microbiological importance.

Keywords: *Monomorium pharaonis*, *Staphylococcus*, hospital infection, public health.

Formigas associadas a microorganismos patogênicos em hospitais brasileiros: a atenção para um vetor

RESUMO. A presença de formigas em hospitais constitui risco a saúde da comunidade hospitalar, uma vez que possuem o poder de carrear microrganismos patogênicos. Este estudo foi realizado com o objetivo de comentar publicações referentes à ocorrência de formigas associadas a microrganismos patogênicos em hospitais no Brasil. Os estudos indicam que foram coletadas formigas em diversas unidades hospitalares de 13 hospitais, em cinco estados nas regiões Sul e Sudeste. A análise microbiológica permitiu identificar nas formigas microrganismos como *Staphylococcus*, *Streptococcus*, *Klebsiella*, *Escherichia coli*, *Pseudomonas*, *Streptococcus* entre outros de importância microbiológica.

Palavras-chave: *Monomorium pharaonis*, *Staphylococcus*, infecção hospitalar, saúde pública.

Introduction

Ants are social insects found almost everywhere and have higher diversity in tropical regions. These insects cause problems in hospitals worldwide (BEATSON, 1972), was the first reporting the occurrence of ants in nine hospitals in the United Kingdom, then in England (EDWARD; BACKER, 1981), Chile (IPINZA-REGLA et al., 1981); Germany (EICHELER; 1990) and Trinidad (CHADEE; MAITRE, 1990), Colombia (OLAYA-MASMELA et al., 2005), Spain (ESPALDER; ESPEJO, 2002), United States (KLOTZ et al., 1995; NELDER et al., 2006), Malaysia (NA; LEE, 2001), and Korea (KIM et al., 2005).

In Brazil, studies have initiated in the 90's with the identification of 14 ant species (FOWLER et al., 1993), Bueno and Fowler (1994) investigated 20 hospitals in Brazil, and the ant fauna in each hospital consisted of between 10 and 23 species.

Among the factors affecting the presence of ants in hospitals, highlights the architectural structure, proximity to residences, weather interferences, temperature variations that stimulate the migration of these insects to electronic devices searching for thermal stability and/or packages of drugs that provide suitable conditions for nesting, besides foodstuffs that function as extra attractive (BEATSON, 1972; ZARZUELA et al., 2002).

With the growing concern about the occurrence of ants in these environments, several studies have been undertaken in Brazil aiming to verify the potential of these organisms to carry pathogenic microorganisms, and the results have indicated their role as mechanical vector, contaminating the environment and collaborating to nosocomial infections (BUENO; FOWLER, 1994; FOWLER et al., 1993, MOREIRA et al., 2005). This discussion is justified because it is essential that health professionals to know and be aware of the need to control and monitor the presence of these insects, since currently hospital infections are a serious public health problem in the country.

Although ants are not considered the major source of hospital infections, are viewed as any other vehicle of transmission (FOWLER et al., 1993). For

immunosuppressed patients, susceptible to develop infections, this exposure may change the prognosis, increasing the length and cost of hospitalization (IPINZA-REGLA et al., 1981).

This study examined the occurrence of ants in Brazilian hospital environments over the last decade, by means of a literature review, focusing on the distribution and potential of ants to carry pathogenic microorganisms, once ants in hospital settings may transport diverse bacterial species (gram-positive and gram-negative), considering that some strains may be multidrug-resistant. The Table 1 lists results from 13 studies performed in Brazil, with the species of ants collected in hospitals, microorganisms carried by them, and hospital wards in which they were collected.

Material and methods

For this study we used the systematic review using meta-analysis to integrate the results, allowing to describe current knowledge, indicating those aspects that are science-based and those that do not have a solid base of support and require further investigation.

The criteria for selection and inclusion of articles has occurred as the objectives of this study to maintain the rigor and uniformity in the choice of these were complied with some criteria: articles that address the topic, articles indexed in databases LILACS (Latin American Literature in Health Sciences) and MEDLINE (Medical Literature Analysis and Retrieval Sistem online); articles published in national journals within the defined time period from 2001 to 2011.

The key words used for this literature in LILACS and MEDLINE were ants, hospital and vectors.

Results and discussion

The ant diversity registered in Brazil with potential to act as mechanical vector of pathogenic microorganisms in hospital environments is significantly higher than in European countries. *M. pharaonis* is the species found in European hospitals (BEATSON, 1972; EICHLER, 1990; ULLOA, 2003). Fowler et al. (1993) considered that the ant species predominant in Brazil are the exotic *M. pharaonis* and *T. melanocephalum*.

Surveys in five Brazilian states indicated that some species are predominant in hospitals, and the occurrence of *T. melanocephalum* was predominant (TANAKA et al., 2007; TEIXEIRA et al., 2009), followed by *P. longicornis*. These and other species listed in Table 1 are mechanical vectors for nosocomial infections, since were identified pathogens such as *Staphylococcus*, *Enterococcus*, *Klebsiela*, *Escherichia coli*, *Pseudomonas* and *Streptococcus* carried by them in different hospital wards (BELEI et al., 2006; COSTA et al., 2006; FOWLER et al., 1993; GARCIA et al., 2011; LISE et al., 2006; MOREIRA et al., 2005; PESQUERO et al., 2008; RANDO et al., 2009; SANTOS et al., 2009; TANAKA et al., 2007; TEIXEIRA et al., 2009).

The identification of pathogenic microorganisms in the ants analyzed, along with biological traits, can define ants as potential carriers of pathogens and the infestation in hospitals is a risk to public health (BEATSON, 1972). The association between enterobacteria and ants has been observed in some Brazilian hospitals, which always represents a risk to hospitalized patients. Enterobacteria are common among insects, and horizontally transmitted from one to another individual, but can be acquired from the environment, showing thus capacity of propagation and maintenance of the microorganism in the environment (MOREIRA et al., 2005, PEREIRA; UENO, 2008, PESQUERO et al., 2008).

Ants can move upon human material such as urine, feces, sputum, and carry the microorganisms to the utensils and surfaces in general. Among the microorganisms identified in the ants is the group of fecal coliforms, including *Escherichia, Enterobacter* and *Klebsiella*, present in human feces by being part of the intestinal flora; and Staphylococcus aureus, on the human skin and nasopharynx, is the responsible for the most of nosocomial infections (TRABULSI, 1991).

Regarding the *Escherichia coli*, even being part of the gastrointestinal tract of humans it has been reported as one of the most important agents for extraintestinal infections, such as diarrhea in adults and children, and experimental keratoconjunctivitis, an infection similar to shigellosis (JAWETZ et al., 1998). Thus, the problem becomes relevant in the studied hospitals, once this bacterium was identified in ants *Odontomachus* sp and *Pheidole* sp1 and sp2 found in areas with the presence of children, such as nursery and maternity (SANTOS et al., 2009).

Ants have great capacity to maintain the association between bacteria and fungi, including some antibiotic-resistant pathogenic species, characterizing a condition of risk of nosocomial infection (PANTOJA et al., 2009; PEREIRA; UENO, 2008). Among the multiresistant strains, stand out the genera *Acinetobacter*, *Streptococcus*, Gemella, *Enterococcus faecalis* and *Klebsiella* (MOREIRA et al., 2005; TRABULSI, 1991) and *K. Pneumomiae* (TANAKA et al., 2007). Thus, it is evident the importance of the problem in the public health area, once these bacteria are becoming increasingly resistant to a higher number of antibiotics.

Table 1. Species of ants, microorganisms carried by them, and hospital units examined by the 14 Brazilian studies.

Title	Authors	Ant species	Microorganisms	Hospital unit
Ants as carriers of resistant bacteria in hospitals	Moreira et al. (2005)	*Tapinoma melanocephalum*; *Paratrechina longicornis*; *Monomorium pharaonis*; *Solenopsis saevissima*;	*Bacillus* spp.; *Enterobacter amnigenus*; *Enterobacter cloacae*; *Enterococcus faecalis*; *Klebsiella pneumoniae*; *Staphylococcus saprophyticus*; *Acinetobacter baumanni*; *Gemella morbillorum*; *Staphylococcus epidermidis*; *Staphylococcus equorum*; *Klebsiella oxytoca*; *Staphylococcus aureus*; *Staphylococcus simulans*; *Staphylococcus warneri*; *Serratia rubidae Staphylococcus cohnii Bacillus* spp. *Enterobacter agglomerans*; *Gemellaha emolysans*; *Enterococcus faecium*; *Gemellaha emolysans*; *Streptococcus acidominimus*; *Staphylococcus lugdunensis.*	Adult and pediatric wards, Cardiology, gynecology, trauma, postopoerative; Adult and pediatric ICU.
Occurrence, behavior, and vectoring of fungi by ants in the hospital of the Federal University of Juiz de Fora, Minas Gerais State	Barros et al. (2006)	*Camponotus* sp., *Camponotus crassus*; *C. atriceps*; *C. renggeri*; *Wasmannia auropuntata*; *Paratrechina longicornis*; *M. floricola*; *Pheidole* sp., *Tapinoma melanocephalum*; *Odontomachus* sp.	*Aspergillus* sp.; *Cladosporium* sp.; *Penicillium* sp.; *Candida* sp. and *Aspergillus niger.*	Not specified
Ants: analysis on microorganisms carried in the hospital environment	Belei et al. (2006)	Not specified	*Filamentous fungi, Coagulase negative staphylococci, acinetobacter* sp.; *micrococcus* sp.; and *bacillus* sp..	NICU and other hospital units.
Ants as mechanical vectors of microorganisms in the school hospital of the Federal University of triângulo mineiro	Costa et al. (2006)	*Tapinoma melanocephalum*; *Pheidole* sp. and *Paratrechina Longicornis.*	*Staphylococcus* sp.; Gram-positive bacilli, *Pseudomonas* sp.; and *Micrococcus* sp..	Wards, service of nutrition and dietetics, and pediatric ICU
Association between ants (Hymenoptera: Formicidae) and bacteria in hospitals of Santa Catarina State	Lise et al. (2006)	*Monomorium pharaonis*; *Solenopsis saevissima*; *Paratrechina longicornis*; *Brachymyrmex* sp.; *Solenopsis* sp.; *Camponotus* sp.; *Tapinoma melanocephalu.*	*Acinetobacter* sp.; *Acinetobacter haemolyticu*; *Oerskovia* sp.; *Corynebacterium* sp.; *Corynebacterium diphtheriae*; *Corynebacterium jeikeium*; *Enterococcus* sp.; *Listeria monocytogenes*; *Neisseria* sp.; *Planococcus* sp.; *Pseudomonas luteola*; *Sphingobacterium* sp.; *Sphingomonas paucimobilis*; *Staphylococcus* sp.; *Staphylococcus intermedius*; *Staphylococcus saprophyticus*; *Stenotrophomonas maltophilia*; *Streptococcus agalactiae*; *Streptococcus bovis*;. *Neisseria* sp.; *Planococcus* sp. and *S. agalactiae*.	Adult inpatient unit, surgical, oncology and pediatrics.
Urban ants and the transport of nosocomial bacteria	Rodovalho et al. (2007)	*Tapinoma melanocephalum* and *C. vittatus*	Coagulase positive staphylococci, Coagulase negative staphylococci and Gram-negative bacilli.	Unit of infectious diseases, emergency room, and burn unit
Bacteria carried by ants in hospital environment	Tanaka et al. (2007)	*Monomorium pharaonis* and *Tapinoma melanocephalum.*	*Corinebacterium* sp.; *Klebsiella pneumoniae*; *K. ozaenae*; *Escherichia coli*.	Nursery, surgical center, nursing station, sterilizing room, blood donation room, and ICU
Ants as microorganism carriers in hospitals	Pereira e Ueno (2008)	125 ants of the same not-specified species	*Hafnia alvei*; *Klebsiella pneumoniae*; *Enterobacter aglomerans*; *Enterobacter cloacae*; *Enterobacter sakazakii*; *Serratia liquefaciens*; *Serratia marcescens.* *Epidermopgyton floccosum*; *Trichophyton rubrum*; *Trichophyton verrucosun*; *Clodosparium carruoni*; *Aurobasidium pullulans*; *Wangiella dermatitidis*; *Conidiobolus coronalus*; *Fonsecaea pedrosoi*; *Aspergillus niger*; *Aspergillus flavus*; *Aspergillus fumigatus*; *Monilia sitophita.*	Medical clinic, blood unit, laundry, and orthopedics.

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Title	Authors	Ant species	Microorganisms	Hospital unit
Ants in hospital environment and their potential to transmit bacteria	Pesquero et al. (2008)	*Pheidole* sp1; *Hipoponera* sp1; *Dorymyrmex pyramicus*; *Linepithema humile*; *Camponotus* sp1; *Brachymyrmex* sp1; *Brachymyrmex* sp2; *Paratrechina fulva*; *Cardiocondyla* sp1;	*Escherichia coli*; *Staphylococcus* sp.; *Enterococcus* sp.; *Klebsiella* sp.; *Salmonella* sp. *and Aeromonas* sp.	Restrooms, nursery, medical offices, kitchen, sterilizing room, hematology, laboratory, milk kitchen unit, nursing station, suture room, plaster room, Adult and pediatric ICU
Ants (Hymenoptera: Formicidae) as bacterial vectors in two hospitals of the municipality of Divinópolis, Minas Gerais State	Santos et al. (2009)	*Pheidole* sp1 and sp2; *Linepithema humile*; *Wasmannia auropunctata*; *Camponotus* sp.; *Odontomachus* sp; *Solenopsis* sp.; *Acromyrmex* sp.; and *Tapinoma melenocephalum.*	*Escherichia coli*; *Pseudomonas aeruginosa*; *pathogenic and non-pathogenic Staphylococcus* spp; *Streptococcus faecalis* and other *Enterococcus* sp.	Warehouse, nursery, chapel, sterilizing room, surgical center, medical clinic, drugstore, kitchen, bedrooms, laboratory, maternity, ICU, radiology.
Characterization of ant fauna in establishments of health area in the municipality of Bandeirantes, Paraná State.	Rando et al. (2009)	*Tapinoma melanocephalu*; *Paratrechina fulva*; *Monomorium pharaonis*; *C. atriceps*; *Brachymyrmex* sp.; *Pheidole* sp.4; *Pheidole* sp.3; *Pheidole* sp.2; *Pheidole* sp.1; *Dorymyrmex* sp.	*Staphylococcus* sp.; *Serratia* sp.; *Klebsiella* sp.; *Escherichia coli*; *Salmonella* sp.; and *Pseudomonas* sp..	Surgical center, hallways, drugstore, laundry, nursing stations, reception, adult and pediatric inpatient units, and ICU
Microbiota associated with urban ants in a Brazilian university hospital.	Teixeira et al. (2009)	*Tapinoma melanocephalum.*	*Gram-positive bacilli*, *Gram-negative bacilli*, *Gram-positive cocci*, *Filamentous fungi*, *Pseudomonas*; *Staphylococcus*; and *Streptococcus.*	Surgical center, and ICU.
Ants (Hymenoptera: Formicidae) as carriers of fungi in hospitals: emphasis on genera *Tapinoma* and *Pheidole*	Pantoja et al. (2009)	*Tapinoma melanocephalum*; *Paratrechina longicornis*; *Camponotus*; *Solenopsis*; *Pheidole.*	*Absidia* sp.; *Acremonium* sp.; *Acremonium hyalinulum*; *Aspergillus flavus*; *Aspergillus niger*; *Aspergilluso chraceus*; *Aspergillus oryzae*; *Aspergillus sydowii*; *Aspergillus versicolor*; *Chrysosporium inops*; *Cladosporium Sphaerospermum*; *Cokeromyces* sp.; *Cunninghamella Bertholletiae*; *Cyphellophora* sp.; *Fusarium* sp.; *Fusarium proliferatum*; *Fusarium solani*; *Mortierella*;*polycephala*; *Mucor* sp.; *Mycocentrospora*;*acerina*; *Ochroconis gallopava*; *Paecilomyces marquandii*; *Paecilomyces variotii*; *Penicillium* sp. *Rhinocladiella aquaspersa*; *Scopulariopsis koningii*; *Scytalidium* sp.; *Tritirachium oryzae*; *Candida albicans*; *Candida glabrata*; *Candida guilliermondii*; *Candida parapsilosis*; *Rhodotorula* sp.; *Rhodotorula mucilaginosa*; *Saccharomyces* sp.	NICU, adult ICU, surgical center, transplant units, pediatrics, hematology, surgery, gynecology.
Association between ants (Hymenoptera: Formicidae) and pathogenic bacteria in five hospitals in the city of Pelotas	Gonçalves et al. (2011)	*Cardiocondyla emeryi Pheidole nubila*, *Pheidole spininodis*, *Pheidole* sp.1, *S. saevissima*, *Tetramorium bicarinatum*,	Enterobacteria, *Pseudomonas aeruginosa*, *Pseudomonas fluorescens*, *Pseudomonas putida*, *Staphylococcus epidermidis* and *Staphylococcus saprophyticus*	Surgical center, hallways, drugstore, laundry, nursing stations, reception, adult and pediatric inpatient units, and ICU

The inpatient units for adults and children, Intensive Care Units (ICU) for adults and children, as well as nursery, surgical centers, nursing stations, sterilizing rooms, kitchens and laboratories are among the wards with high infestation of ants (COSTA et al., 2006; LISE et al., 2006; MOREIRA

et al., 2005; PESQUERO et al., 2008; RANDO et al., 2009; SANTOS et al., 2009; TANAKA et al., 2007; TEIXEIRA et al., 2009). Among them, some units with critically ill patients such as ICU, surgical centers and nurseries, receive a lower flow of people and materials, and have a higher frequency of environmental hygiene, then it was expected a lower index of infestation of ants than observed (BRAGANÇA; LIMA, 2010). However, their presence was not related to the lack of cleaning, some species are attracted to sterilized materials, serum and medications used.

Multiresistant bacterial strains isolated from ants in places such as nurseries indicate a direct effect on disease transmission and consequently on increased rates of infection and severity of nosocomial infections. Undoubtedly, this needs to be discussed with sectors related to prevention of hospital infection (TANAKA et al., 2007).

According to these studies, ants in hospitals should be considered a threat to human health, because they are vectors of pathogenic bacteria, but not associate the presence of ants with indices of nosocomial infections, nor neglect their presence, without controlling or monitoring their presence in these environments (CINTRA-SOCOLOWSKI, 2007).

Conclusion

The presence of ants in hospitals should receive attention since they can carry diverse bacterial species, including multiresistant strains. In this way, ants in this environment should warn the CCIH and all multidisciplinary team for the effective control of nosocomial infections, because only with the participation of the entire hospital community it will be possible to develop from basic measures, such as hand washing, and the maintenance of a clean working environment, to the control of ants, but the professional awareness comes to the fore as prevention.

This problem can be minimized by adopting some measures to control ants in hospitals, such as the ban on entry of food and flowers, cover small cracks on the walls, removal of tree branches close to the windows and outside walls, removal of debris in the outer area. Because several factors favor the occurrence of ants in hospitals, including the deficient structure, even with efforts of a committee on hospital infection control, given the circulation of a large amount of people (patients, relatives, employees, suppliers) and goods (clothes, foodstuffs, flowers, and other objects) that favor the entry of these insects, in addition to the drugs that attract them.

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