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CHARACTERIZATION OF URINARY TRACT INFECTIONS AND THEIR RELATIONSHIP WITH THE VARIOUS HOSPITAL ENVIRONMENTS

CARACTERIZAÇÃO DAS INFECÇÕES DO TRATO URINÁRIO E A RELAÇÃO COM OS DISTINTOS AMBIENTES HOSPITALARES

CARACTERIZACIÓN DE LAS INFECCIONES DEL SISTEMA URINARIO Y SU RELACIÓN CON LOS DIFERENTES AMBIENTES HOSPITALARIOS

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ABSTRACT

Objective: to characterize the urinary tract infections through the results of urocultures conducted by a hospital diagnostic laboratory and relate them to the various hospitalization sectors. ***Method:*** this is a quantitative, cross-sectional, documentary, and retrospective study, with analysis of data recorded in the files of the Laboratory of Microbiology of the University Hospital Onofre Lopes (HUOL) of the Federal University of Rio Grande do Norte (UFRN), in Natal, Rio Grande do Norte, Brazil. The study was approved by the Research Ethics Committee of UFRN, under the CAAE 03015412.0.0000.5537. ***Results:*** 8,202 examinations were performed. The final sample totaled 997 examinations. *Escherichia coli* was the predominant organism in clinical-surgical and renal transplantation wards; in turn, in the intensive care unit (ICU) prevailed candidemia. ***Conclusion:*** the characterization of urinary tract infections at various hospital sectors may contribute so that control measures are taken for a nursing care adequate to microbial control. ***Descriptors:*** Cross Infection; Urinary System; *Escherichia coli*.

RESUMO

Objetivo: caracterizar as infecções do trato urinário a partir de resultados de uroculturas realizadas por laboratório de diagnóstico hospitalar e relacioná-las aos distintos setores de internação. ***Método:*** trata-se de estudo quantitativo, transversal, documental e retrospectivo, com análise de dados registrados nos arquivos do Laboratório de Microbiologia do Hospital Universitário Onofre Lopes (HUOL) da Universidade Federal do Rio Grande do Norte (UFRN), em Natal (RN). O estudo foi aprovado pelo Comitê de Ética em Pesquisa da UFRN, sob o CAAE n. 03015412.0.0000.5537. ***Resultados:*** foram realizados 8.202 exames. A amostra final totalizou 997 exames. A *Escherichia coli* foi o microrganismo predominante nas enfermarias clínico-cirúrgicas e de transplante renal; já na unidade de terapia intensiva (UTI) prevaleceu a candidemia. ***Conclusão:*** a caracterização das infecções do trato urinário em distintos setores hospitalares pode contribuir para que medidas de controle sejam tomadas para uma assistência de enfermagem adequada ao controle microbiano. ***Descritores:*** Infecção Hospitalar; Sistema Urinário; *Escherichia coli*.

RESUMEN

Objetivo: caracterizar las infecciones del sistema urinario desde resultados de urocultivos realizados por el laboratorio de diagnóstico hospitalario y relacionarlas con los diferentes sectores de hospitalización. ***Método:*** esto es un estudio cuantitativo, transversal, documental y retrospectivo, con análisis de datos registrados en los archivos del Laboratorio de Microbiología del Hospital Universitario Onofre Lopes (HUOL) de la Universidad Federal de Rio Grande do Norte (UFRN), en Natal, Rio Grande do Norte, Brazil. El estudio fue aprobado por el Comité de Ética en Investigación de la UFRN, bajo el CAAE 03015412.0.0000.5537. ***Resultados:*** se realizaron 8.202 exámenes. La muestra final fue de 997 exámenes. *Escherichia coli* fue el organismo predominante en las salas de enfermería clínicas y quirúrgicas y de trasplante renal; ya en la unidad de cuidados intensivos (UCI) ha prevalecido la candidemia. ***Conclusión:*** la caracterización de las infecciones del sistema urinario en diferentes sectores hospitalarios puede contribuir a que las medidas de control sean tomadas para una atención de enfermería adecuada al control microbiano. ***Descriptores:*** Infección Hospitalaria; Sistema Urinario; *Escherichia coli*.

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INTRODUCTION

Cross infection (CI) represents a major public health problem around the world, with severe repercussions to patients who contract it. We notice that it has become the leading cause of iatrogeny in hospitalized patients when undergoing procedures with palliative and/or curative purposes.[1] This is something contradictory, since the main reason for hospitalization would be cure and not the emergence of other comorbidities that compromise the individual's health restoration and maintenance.[2]

CI can occur through intrinsic factors, inherent to the patient her/himself. However, it is noticed that the invasive procedures to which she/he is subject and the hospital environment itself also favor the installation of infections.[3] Thus, studies in the clinical field reveal that urinary tract infections (UTIs) represent the most common sites of nosocomial infection, involving, on average, from 25 to 45% of hospitalized clients and they derive from the invasion and multiplication of pathogenic microorganisms in the urinary tract. This illness stems from viruses, fungi, both in rare cases; but, mainly, from bacteria, especially those gram-negative.[4]

The bacteria most commonly found to cause UTIs in the hospital environment are *Escherichia coli, Proteus spp., Pseudomonas aeruginosa, Klebsiella spp., Enterobacter spp.,* and *Enterococcus spp.* In the class of fungi there is a predominance of *Candida spp.* These, generally, inhabit the usual flora in the gastrointestinal tract. However, usually, these fecal microorganisms, through the perineal region, reach the urethra and/or bladder and infect the entire urinary system of this individual. They attach to the epithelium in the urinary tract and, in turn, trigger a mucosa colonization process, which then triggers the uropathogenesis.[5]

UTIs are classified according to their location in the urinary tract. The lower UTI is named cystitis, prostatitis, or urethritis, and it depends on the portion suffering the pathogenic proliferation. In turn, the upper UTIs can damage kidneys and renal pelvis and trigger complications such as acute and chronic pyelonephritis, renal and perirenal abscesses, and interstitial nephritis. However, it is worth mentioning that when the infection affects the kidney, it represents something much more severe.[6]

There are also uncomplicated lower UTIs, which are those contracted in daily contact within a society through cross-transmission that rather affect more young women. Finally, there is complicated lower or upper UTI that significantly compromises renal function.[6]

Regarding symptoms, is common in lower UTIs (e.g. cystitis) dysuria, pollakiuria, hypogastric pain, nocturia, urinary urgency, and, sometimes, turbid urine. In turn, upper UTIs (e.g. pyelonephritis) are characterized by the triad fever, chills, and back pain, besides bacteriuria and leucocyturia in laboratory findings.[6]

It is also noticed that UTIs mainly affect the adult individuals, women, because the latter has a shorter urethra and it is closer to the anus, when compared to men. However, among the elderly male population, there is a predominance of obstructive uropathies, reducing the physiological bactericide property of prostatic secretions and poor bladder emptying, besides other clinical problems that contribute to the onset of UTI. It is estimated that the incidence among this group reaches 15% of elderly men.[7]

To reverse this situation, it is key to implement a model for preventing and controlling CI mainly grounded in professional training and continued education of health teams. There is also a need that professionals create effective actions and measures when fighting nosocomial infections, strictly following the protocol recommended by the Committee on Hospital Infection Control (CCIH) of the institution concerned. So, overcoming this challenge will significantly contribute to achieve an excellent quality of care.[8]

OBJECTIVE

- To characterize the UTIs through the results of urocultures conducted by the hospital diagnostic laboratory of the institution under study, between 2007 and 2011, and relate them to the various hospitalization sectors.

METHOD

This study has a quantitative, cross-sectional, approach and a retrospective documentary basis, and it concerns the evaluation of data collected from the record books of uroculture examinations, filed at the Microbiology Sector of the Central Laboratory of the University Hospital Onofre Lopes (HUOL) of the Federal University of Rio Grande do Norte (UFRN), located in Natal, Rio Grande do Norte, Brazil. This institution provides the state's population with service for over a century, and it is regarded as a

referral hospital in highly complex services, specialized in kidney, liver, and corneal transplantation. It offers to users more than 30 different specialties, particularly transplantations, oncology, cardiac, and neurological surgeries. It currently has a total of 231 beds arranged into 5 floors, whose physical area corresponds to 30,000 m².

In this study, the population comprises all adult clients (> 18 years) who underwent uroculture examination, hospitalized in HUOL within the period from January 2007 to December 2011. Data collection was conducted from September to December 2012. The variables used in the research were sex, age (years), patient's sector of origin, day, month, and year of collection, and the release of examinations, in addition to their results.

We analyzed the sectors of clinical and surgical wards, as well as specialty wards, including the renal ward, the general and cardiology intensive care units (ICUs), in addition to the beds of nephrology, which cover the admissions of patients suffering from kidney problems and those undergoing transplantation.

Within the period concerned, a total of 8,202 uroculture examinations were performed. Out of these, 1,033 were related to positive results for this exam, which, after analysis of results and exclusion of those inconclusive or incomplete/indeterminate, culminated in a final sample of 997 examinations for this study. Repeat examinations were considered only once for the positive or negative result, when no infectious agent was detected.

Data were collected by means of a specific form for cataloging the results of analyzed examinations. To evaluate data, we used the software *Microsoft Excel*, for constituting the information database, in addition to the software *Epi-Info*, version 3.5.2, for descriptive and inferential analysis.

This study was approved, regarding its ethical and methodological aspects, by the Research Ethics Committee of UFRN, under the Opinion 98,310/2012 and the CAAE 03015412.0.0000.5537.

RESULTS

The positive results of urocultures within the study period consisted of 535 cases for the male population (53.7%) and 462 cases for the female population (46.3%), however, in 2009, a dominance reversal took place, when the female clientele (53.3%) overcame the male clientele (46.7%). The largest difference occurred in 2010, when there was the greatest gap in percentage between the sexes, as 42.1% of cases involved women and 57.9% involved men.

Regarding the total number of each year, we observed that 2011 had the highest amount of positive urological examinations, 280 cases. On the other hand, 2009 had the lowest occurrence, which totaled 137 positive examinations (Table 1).

Table 1. Distribution of uroculture examinations with positive results by year and sex. Natal, 2007-2011 (n = 997).

Sex	2007		2008		2009		2010		2011	
	N	%	N	%	N	%	N	%	N	%
Female	89	45.9%	69	46.6%	73	53.3%	101	42.1%	130	46.4%
Male	104	54.1%	79	53.4%	64	46.7%	139	57.9%	150	53.6%
Total	**193**	**100%**	**148**	**100%**	**137**	**100%**	**239**	**100%**	**280**	**100%**

HUOL had in 2011, final year of this study, a total of 189 beds, out of which 79 were aimed at providing care for patients from the medical clinic, which included specific wards for renal treatment, 97 for the surgical clinic with beds aimed at kidney transplant patients, 10 beds for adult general ICU, and 3 beds for psychiatry. Among the sectors characterized in the research, the wards stood out with regard to the number of conclusive results of examinations for UTI, with 751 out of the 997 cases. It is worth taking into account that this high number is associated with the fact that this is the sector having the highest number of hospitalized patients.

The amount of infections in this sector showed to be proportional to the number of beds. At wards, UTIs were more frequent among male patients, representing 57.4%. However, in the ICU and in specific wards for providing nephrology patients with care, which include beds aimed at kidney transplant patients, the inverse occurred, with a higher frequency among females, respectively with 56.8% and 57.1% (Table 2).

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Table 2. Distribution of positive uroculture examinations by hospital sector and sex. Natal, 2007-2011 (n = 997).

Sex	Wards*		ICU**		Nephrology***	
	N	%	N	%	N	%
Female	320	42.6%	84	56.8%	56	57.1%
Male	431	57.4%	64	43.2%	42	42.9%
Total	**751**	**100%**	**148**	**100%**	**98**	**100%**

* Sectors of hospitalization wards for clinical and surgical care, except renal.

** General adult ICU.

*** Wards for renal specialized treatment and renal transplant patients.

The age of patients in the positive uroculture results ranged from 18 to 94 years, with a mean age of 56 years. It is worth mentioning that it was a hospital providing care for adult patients only, therefore, there was not pediatric care.

Regarding the age variable, there was a loss of 476 cases, because there is no note on this information in record books of uroculture examinations for all those performed at the Microbiology Sector of the Central Laboratory of HUOL. So, the age groups were defined considering 521 cases.

Table 3 shows by sector the frequencies of established age intervals. In the wards (53.3%) and ICU (54.3%) sectors there was highlight on more than half of the cases with increased frequency of UTI among the elderly population, ≥ 61. In turn, in nephrology sectors, we observed a higher frequency between 18 and 30 years of age (40%), followed by the interval from 41 to 50 years (37.5%). Therefore, the predominance already highlights the young adult individual, with lower frequency at older ages.

Table 3. Distribution by age group and hospitalization sectors for cases of urinary tract infection. Natal, 2007-2011 (n = 521).

Age group	Wards*		ICU**		Nephrology***	
	N	%	N	%	N	%
18-30 years	24	6.0%	10	12.0%	16	40.0%
31-40 years	39	9.7%	05	6.0%	05	12.5%
41-50 years	69	17.3%	15	18.0%	15	37.5%
51-60 years	54	13.7%	08	9.7%	01	2.5%
≥ 61 years	212	53.3%	45	54.3%	03	7.5%
Total	**398**	**100%**	**83**	**100%**	**40**	**100%**

* Sectors of hospitalization wards for clinical and surgical care, except renal.

** General adult ICU.

*** Wards for renal specialized treatment and renal transplant patients.

In Table 4, the etiologic agents that prominently showed higher frequency on the positive results of uroculture were *Escherichia coli* (37.0% of the female population and 23.1% of men), followed by *Klebsiella spp*. (20.6% of women and 16.6% of men). Other agents that stood out were *Candida spp.*, yeast cells, *Enterococcus spp.*, *Proteus mirabilis, Acinetobacter spp.*, among others with lower frequency, considering some results with multiple agents.

Table 4. Urinary tract infections by etiologic agent and sex, according to results of uroculture examination. Natal, 2007-2011 (n = 997).

Microorganisms found	Female		Male	
	N	%	N	%
Acinetobacter spp.	14	3.0%	31	5.8%
GNNFB + *Pseudomonas aeruginosa*	6	1.2%	6	1.1%
Candida spp.	38	8.6%	29	5.4%
Yeasts and other fungi	28	6.0%	10	1.9%
Citrobacter spp.	3	0.6%	8	1.5%
Enterobacter spp. + associations	14	3.2%	45	8.2%
Enterococcus spp.+ associations	18	3.9%	28	5.0%
Escherichia coli	171	37.4%	124	23.0%
Escherichia coli + Proteus vulgaris	0	0.0%	1	0.2%
Klebsiella pneumoniae	4	0.8%	3	0.6%
Klebsiella spp.+ associations	96	20.8%	99	18.3%
Morganella morganii	1	0.2%	3	0.6%
Proteus mirabilis + associations	15	3.5%	32	6.0%
Proteus vulgaris + associations	7	1.5%	20	3.7%
Pseudomonas aeruginosa	9	1.9%	43	8.0%
Pseudomonas spp. + associations	13	2.8%	25	4.7%
Pseudomonas aeruginosa + associations	1	0.2%	5	1.0%
Salmonella spp.	0	0.0%	1	0.2%
Serratia spp.	0	0.0%	2	0.4%
Staphylococcus aureus	7	1.4%	4	0.8%
Staphylococcus saprophyticus	1	0.2%	1	0.2%
Staphylococcus spp.	9	1.8%	13	2.6%
Streptococcus spp.	5	1.0%	4	0.8%
Total	**460**	**100.0%**	**537**	**100.0%**

When analyzing the etiologic agents by hospital sector, the results of higher frequencies remained with the microorganisms *Escherichia coli* and *Klebsiella* spp. in all sectors, however, when considering the number of beds and the frequency of agents found, an emphasis was given to the occurrence of *Candida spp.* and yeast cells as causers of UTI at the ICU, as described in Table 5.

Table 5. Urinary tract infections by etiologic agent and hospitalization sector, according to data from uroculture examination. Natal, 2007-2011 (n = 997).

Microorganisms	Wards*		ICU**		Nephrology***	
	N	%	N	%	N	%
Acinetobacter spp.	34	4.5%	8	5.4%	3	3.0%
GNNFB	11	1.4%	1	0.7%	0	0.0%
Candida spp.	37	4.9%	26	17.6%	5	5.1%
Yeasts and other fungi	24	3.2%	13	8.8%	1	1.0%
Citrobacter spp.	11	1.5%	0	0.0%	0	0.0%
Enterobacter spp. + associations	48	6.3%	6	4.1%	6	6.1%
Enterococcus spp. + associations	35	4.6%	8	5.4%	3	3.0%
Escherichia coli	226	30.0%	29	19.6%	40	41.0%
Escherichia coli + Proteus vulgaris	1	0.1%	0	0.0%	0	0.0%
Klebsiella pneumoniae	6	0.8%	1	0.7%	0	0.0%
Klebsiella spp. + associations	135	18.1%	26	17.6%	32	31.9%
Morganella morganii	4	0.5%	0	0.0%	0	0.0%
Proteus mirabilis + associations	45	6.2%	2	1.4%	0	0.0%
Proteus vulgaris + associations	23	3.1%	4	2.7%	0	0.0%
Pseudomonas aeruginosa	44	5.7%	7	4.8	2	2.0%
Psedomonas spp. + associations	31	4.0%	6	4.1%	2	2.0%
Pseudomonas aeruginosa + associations	1	0.1%	3	2.1%	0	0.0%
Salmonella spp.	1	0.1%	0	0.0%	0	0.0%
Serratia spp.	2	0.3%	0	0.0%	0	0.0%
Staphylococcus aureus	8	1.4%	2	1.4%	1	1.0%
Staphylococcus saprophyticus	2	0.3%	0	0.0%	0	0.0%
Staphylococcus spp.	15	2.0%	6	4.1%	1	1.0%
Streptococcus spp.	7	0.9%	0	0.0%	2	2.0%
Total	**751**	**100%**	**148**	**100%**	**98**	**100%**

* Sectors of hospitalization wards for clinical and surgical care, except renal.

** General adult ICU.

*** Wards for renal specialized treatment and renal transplant patients.

DISCUSSION

The wards had the highest number of elderly patients with the comorbidity concerned. A study revealed that UTIs commonly emerge in elderly people of both sexes with percentage variations between 5 and 43% for women and 2 and 21% for men.[9] In data analysis, the research brought similar results, there was a prevalence of elderly patients with UTI in a total of 260 clients in the age group ≥ 61 years. However, there was more men due to the fact that they were predominant in the wards of the institution under analysis; also, we can associate with wards a higher number of UTI because it represents the sector with the highest number of beds, therefore, patients, companions, and professionals, something which significantly increases the spectrum of circulating

pathogens potentially capable of causing infections.

Another study also showed that the elderly population becomes more prone to infection when compared to the young population, because the physiological changes inherent to the aging process, in addition to the ineffectiveness of the immune system and the presence of other comorbidities that makes it more vulnerable to infections, such as UTIs.[10]

A survey conducted in a university hospital in the countryside of the state of São Paulo warn to inappropriate and unnecessary use of urinary catheters in clinical-surgical wards, as well as its length of stay. It was noticed that this practice favored the development of UTI in 47% of local clients who underwent uroculture. In this case, the study also showed that including the catheter becomes an important clinical indicator to control the quality of care provided at that institution.[11]

Through the functional changes of an elderly individual, a survey by the Federal University of Niterói, Rio de Janeiro, Brazil, between 2008 and 2009, with a sample of 66 elderly patients (> 60 years) admitted to a medical and surgical clinics, with 34 of them hospitalized in the medical clinic and 32 in the surgical clinic, nursing diagnoses (NDs) related to geriatric syndromes found among these patients were identified. Within the UTI, impaired urinary elimination due to incontinence represented the most usual ND to clients at the medical clinic (29%) and the surgical clinic (43%). Thus, vesical catheterization or the use of disposable diapers are daily practices in this environment that increase the susceptibility of these individuals to the risk of infections.[12]

UTIs were also observed among hospitalized clients in a neurological ward at the Clinics Hospital in São Paulo, Brazil. Out of the 191 patients with a medical diagnosis of ischemic stroke (IS), 13.9% had clinical complications, such as UTI in individuals > 45 years. In this paper, this disease ranked two, second only to pneumonia.[13]

Another point for discussion concerns the laws and guidelines on the construction of health care facilities. The Ministry of Health recommends that ICUs keep this place at a temperature of 22ºC and a humidity ranging from 50 to 60%.[14] So, in this sector, it is usual to maintain low temperatures by using air conditioners, whose purpose is inhibiting and/or minimizing the growth and spread of infectious agents.

This way, a study conducted in a neonatal ICU points out that air humidity favors fungal colonization, mainly *Candida spp*. Other factors contributing to the emergence of fungi are using some medicines, frequent overcrowding at the sector, and a disproportional clients/nursing professionals ratio, which make the hygiene practices among patients poor. Besides, the latter are associated with the client's context, who is bedridden, something hinders the cleaning of her/his external urogenital organs, something which depends, again, on quality of the service provided by professionals.[15]

Also from this perspective, in the University Hospital of Maringá, Paraná, Brazil, a paper demonstrated a high incidence of candidemias among clients at the ICU using central venous catheter (CVC). The study claims that colonization, usually, occurs due to the very patient's organic condition. However, exogenously hematogenous infections caused by *Candida spp*. may arise from cross-contamination, by the hands of health professionals. The survey also stated that the etiologic agent of the genus *Candida* was responsible for about 80% of fungal infections deriving from this hospital environment.[16] Therefore, although this study has evaluated agents observed in the hands of health professionals, it highlighted the impact that fungi cause on health care services as usual infectious agents at the ICU.

Over five years, a study evaluated 1,676 renal transplant clients with regard to risk factors for infectious complications within the first year after surgery. The survey has shown that immunosuppression was the main triggering factor for the severity of infectious events. UTI was the most prevalent infection in the first months after transplantation, when it was observed in 31.1% of these patients; and *Escherichia coli* was the most frequent causative agent (37%). Men were more affected and the average age of those infected was 41.4 years.[17]

Thus, this research showed the way how clients are exposed to the emergence of UTIs through associated diseases and the consequences during their hospitalization. In contrast, studies reported that reducing nosocomial infections, particularly those in the genitourinary tract, is possible through systematic actions deployed by members of CCIH, grounded in standards and guidelines that regulate and control the routine of health professionals and identify risks and complications that can cause an increase in the length of stay and, also, further readmissions.

CONCLUSION

This study characterized UTIs in a university hospital in Natal, Rio Grande do Norte, Brazil, in order to expose the prevalence of pathogens and the association of their frequencies with the sectors more prone to this condition. Therefore, there were a significant number of clients with positive uroculture results within the analysis period. The use of vesical catheters in hospitalized patients is very frequent, and according to preliminary data from this study, it was found out this is directly associated with urinary tract infectious events.

By means of the results found, *Escherichia coli* was the most common etiologic agent in UTI cases and responsible for the hemostatic body imbalance. Moreover, the sectors where there is a higher frequency of this infectious agent diagnosed by uroculture were the clinical and surgical wards; UTIs mainly affect men > 61 years. In the ICU, due to the specificities inherent to this sector associated with patients' clinical conditions, there was a greater emphasis for fungal proliferation (*Candida* and yeast cells).

It is worth highlighting the frequency of UTIs among patients within the postoperative period in renal transplantation. The use of delay vesical catheters is usual, for a strict control of their urine output. This condition predisposes these patients, who will undergo a more vulnerable immunosuppression, to contract UTI, which may lead to severe complications. Thus, we notice the importance of greater attention on the theme, focusing on health care services, especially hospital-based care, so that they can provide the user with greater safety, in order to pay attention to all invasive procedures in the urinary tract, mainly to actions involved in nursing, which executes the insertion of catheter into the urinary system, as well as its maintenance and handling.

Thus, this study emphasizes the need for commitment and responsibility of professionals who work in the hospitalization sectors, having in mind the high incidence of cross-infection related to UTI. Therefore, the adoption of correct aseptic practices through a theoretical framework grounded in studies addressing the practice will certainly decrease the incidence and consequences to the client. Therefore, by characterizing the UTIs at various hospital sectors, it intends to contribute so that measures to control CI are taken to improve clients' health restoration and promotion, with a view to provide proper care to the actual needs.

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