Culture positivity by hospital bath bed modalities: an ecological study

Positividade de culturas por modalidades de banho no leito hospitalar: estudo ecológico

Positividad de culturas por modalidades de baño en cama hospitalaria: estudio ecológico

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Abstract

Objective: To verify microbiological culture positivity of hospitalized patients, with a nursing prescription for bed bath, in three disjoint and sequential periods of bed bath modalities: conventional (CBB), disposable (DBB) and disposable plus 2% chlorhexidine degerming (DBB-CX).

Methods: This is an ecological, time series study of 48 months, in three periods (P1=CBB; P2=DBB; P3=DBB-CX), with secondary data from electronic medical records of patients who were admitted to a hospital in the state of São Paulo, Brazil.

Results: In the periods of disposable baths, the percentage of culture positivity was, on average, 14.6% lower when compared to the months in which bed bath was conventional. In the DBB-CX period, the percentage of culture positivity was, on average, 19.3% lower when compared to the CBB period months. However, there is no evidence of difference in the percentage of culture positivity between DBB (b = -14.6%; 95%CI = (-18.9% to -10.3%) and DBB-CX (b = - 19.3%;95%CI = (-24.4% to -14.22%) For each year more in patients' mean age, the percentage of culture positivity increases by an average of 0.3% (p=0.060). There was no seasonal association for microbiological culture positivity in bath modalities.

Conclusion: Microbiological culture positivity in patients with a nursing prescription for bed bath is lower when disposable modalities are used. It is recommended to routinely adopt DBB, leaving the prescription of DBB-CX only for skin degermation for invasive and operative procedures and hand hygiene of health professionals.

Resumo

Objetivo: Verificar positividade de culturas microbiológicas de pacientes hospitalizados, com prescrição de enfermagem para banho no leito, em três períodos disjuntos e sequenciais das modalidades de banho no leito: convencional (BLC), descartável (BLD) e descartável acrescido de clorexidina degermante à 2% (BLD-CX).

Métodos: Estudo ecológico, tipo séries temporais de 48 meses, em três períodos (P1=BLC; P2=BLD; P3=BLD-CX), com dados secundários de prontuário eletrônico, de pacientes que estiveram internados em hospital do estado de São Paulo, Brasil.

Resultados: Nos períodos de banhos descartáveis, o percentual de positividade foi, em média, 14,6% menor quando comparado aos meses cujo banho de leito foi convencional. No período de BLD-CX o percentual de positividade foi, em média, 19,3% menor quando comparado aos meses do período de BLC. Contudo, não há evidências de diferença no percentual de positividade entre o BLD (b = -14,6%; IC95% = (-18,9% a -10,3%) e o BLD-CX (b = - 19,3%; IC95% = (-24,4% a -14,22%). A cada ano a mais na idade média do paciente, o percentual de positividade aumenta, em média 0,3% (p=0,060). Não houve associação sazonal para positividades das culturas microbiológicas nas modalidades de banho.

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Conclusão: A positividade de culturas microbiológicas, em pacientes com prescrição de enfermagem para banho no leito, é menor quando se utiliza as modalidades descartáveis. Recomenda-se adotar rotineiramente o BLD, deixando a prescrição de BLD-CX, somente para degermação da pele para procedimentos invasivos, operatórios e higienização das mãos de profissionais de saúde.

Resumen

Objetivo: Verificar los resultados positivos de culturas microbiológicas de pacientes hospitalizados, con prescripción de enfermería de baño en cama, en tres períodos disjuntos y secuenciales de las modalidades de baño en cama: convencional (BCC), descartable (BCD) y descartable con clorhexidina al 2 % (BCD-CX).

Métodos: Estudio ecológico, tipo series temporales de 48 meses, en tres períodos (P1=BCC; P2=BCD; P3=BCD-CX), con datos secundarios de historia clínica electrónica, de pacientes que estuvieron internados en hospital del estado de São Paulo, Brasil.

Resultados: En los períodos de baños descartables, el porcentaje de resultados positivos presentó un promedio 14,6 % inferior en comparación con los meses en que el baño en cama fue convencional. Durante el período de BCD-CX el porcentaje de resultados positivos fue, en promedio, 19,3 % inferior en comparación con los meses del período de BCC. Sin embargo, no hay evidencias de diferencias en el porcentaje de resultados positivos entre el BCD (b = -14,6 %; IC95 % = (-18,9 % a -10,3 %) y el BLD-CX (b = - 19,3 %; IC95 % = (-24,4 % a -14,22 %). Por cada año que se suma a la edad promedio del paciente, el porcentaje de resultados positivos aumenta en promedio 0,3 % (p=0,060). No se verificó una asociación estacional en las respuestas positivas de las culturas microbiológicas en las modalidades de baños.

Conclusión: Los resultados positivos de culturas microbiológicas de pacientes con prescripción de enfermería de baño en cama son menores cuando se utilizan las modalidades descartables. Se recomienda adoptar de forma rutinaria el BCD y dejar la prescripción de BCD-CX solo para la eliminación de los gérmenes de la piel en procedimientos invasivos, quirúrgicos e higienización de manos de los profesionales de salud.

Introduction

The skin, as the largest organ of the human body, covers and protects the body from physical, mechanical, chemical factors, prevents dehydration, maintains thermal regulation, in addition to providing immunological protection and exerting the excretory function. Since it is extensive, it is exposed to microorganisms from both resident and transient flora,[1,2] playing a protective role for the growth of harmful microorganisms[3] and the transient function arising from the transfer of microorganisms from external sources.[1,2]

Human skin undergoes numerous changes over the years, being more sensitive at the extremes of the human life cycle: children, adolescents and older adults. It presents more developed structures in adulthood and important structural changes when older, such as protective skin barrier reduction that is formed by intracellular lipids (ceramides, cholesterol and fatty acids), making the skin susceptible to dehydration and dryness, leading to the development of flakiness, cracks and dryness.[4] Temperature and humidity increase predispose the skin to colonization by bacteria, substantially when regions are kept occluded and, therefore, susceptible to an increase in resident flora colonization density.[5]

Fortunately, the increase in skin moisture, associated with the environmental heat to which the human body is exposed, bring together favorable conditions for the proliferation of hospital microorganisms; therefore, scientific evidence supports that higher temperatures are associated with increased rates of infections caused by bacteria, especially gram-negative ones. Thus, prevention in hospital settings should consider this aspect, since climatic factors influence patients' microbiota composition.[6] Given the expected increase in global temperatures by the end of the century, this topic is relevant from multiple perspectives, including the choice of bed bath modality to be adopted.

Among these modalities, a clinical trial on the skin microbiota of hospitalized and bed bath-dependent patients estimated the efficacy of disposable bed bath (DBB) on skin microbial load of these patients to be 90%, compared to those submitted to conventional bed bath (CBB). This efficacy was 20% for CBB, once colonized 80% of participants. The 4.5 times greater effectiveness of DBB in relation to that of CBB, in preventing the spread of microorganisms, signaled to nursing the need to invest in research to support a review of CBB both in terms of execution and in terms of qualitative and quantitative safety of items used in their operation, so that they do not play the role of fomites.[7]

The results of this trial justify that, although CBB presents benefits,[8] it is assumed that it contributes to the spread of microorganisms in the hospital environment, given the scientific evidence produced by microbiological studies that prove risks

in items used in the procedure, such as basins,[9-11] soap[12] and water,[13] if these are not quality control targets.

This premise was corroborated by experimental research, carried out at the same institution where the clinical trial took place, to compare the effectiveness of 80% alcohol (w/v), rubbed for 30 and 60 seconds, in the manual processing of stainless-steel bath basins, after cleaning with running water and neutral detergent. The research concluded that stainless steel bed bath basins, decontaminated for reuse with 80% alcohol (w/v), after cleaning with running water and neutral detergent, are reservoirs of hospital pathogens. The results of this research justified the search for other decontamination methods or the adoption of DBB, which excludes items that may contribute as fomites.[14] In this way, the institution where the research was developed implemented the use of DBB in three inpatient units and, after two years, the Healthcare-Associated Infection Control Commission (HAICC) determined the use of disposable bed bath with 2% chlorhexidine (DBB-CX) as a strategy to control and reduce the spread of multidrug-resistant microorganisms in the hospital environment, without perhaps considering that, by itself, DBB conferred 90% efficacy on skin microbial load of hospitalized patients.

It is noteworthy that DBB is a bath bag with eight soft non-woven compresses, impregnated with substances that clean and moisturize, preserving the skin's natural lipids, without altering the acid mantle, whose function is related to microorganism resistance.[7,15]

Considering that:

- (a) with the use of DBB, the solution evaporates from the skin naturally between 30 and 45 seconds, leaving it hydrated and protected, without having to be rubbed or dried, in addition to eliminating several of the items mentioned that contribute to cross-contamination, within patients, such as basins, buckets, water, soap, bath gloves, moisturizers and even the use of towels;[16]
- (b) in CBB, the probability that the skin remains with greater humidity, when compared to DBB and, therefore, in the climatic condition in which this humidity is associated with an increase in ambient temperature and in patients' skin, and this association contributes to microbiological growth and consequently to positive cultures;
- (c) due to the experience of a hospital institution, with bed bath modalities in three disjoint and sequential periods of protocol execution, such as CBB, followed by DBB and DBB-CX, we question:

Is the microbiological culture positivity of hospitalized patients with a bed bath prescription different between the three bath modalities?

As a hypothesis, it is assumed that the microbiological culture positivity of hospitalized patients submitted to DBB and DBB-CX modalities are lower when compared to CBB.

This research aimed to verify the microbiological culture positivity of hospitalized patients with a nursing prescription for bed bath, in three disjoint and sequential periods of CBB, DBB and DBB-CX.

In this context, this research aims to assess the impact of three bed bath modalities (CBB, DBB and DBB-CX), to verify the effect on the culture positivity results, guide decision-making by nurses and hospital managers in adopting the safest bath modality.

Methods

This is an ecological trend study, also called a time series, suitable for assessing the impact of actions/interventions, comparing temporal and seasonal trends in the "disease" occurrence before and after the interventions.[17] Specifically, in this research, to analyze the impact of three bed bath modalities instituted as hospital protocols, in three distinct, sequential periods that converged to the exclusive use for each modality.

The study was conducted in three inpatient units (medical clinic I, neurology/neurosurgery, gastrosurgery) of a large public hospital in the state of São Paulo, with a capacity of up to 500 operational beds.

Microbiological culture positivity data as well as sociodemographic data of patients were ob-

tained from the institution's computerized database, electronic patient records, and collected by the Medical Informatics Center (CIMED - *Centro de Informática Médica*). For data collection, on this basis, we used the following keywords: bed bath, urine culture, wound culture, tissue fragment culture, catheter tip culture, tracheal secretion culture, central venous catheter (CVC), peripheral venous access (PVA), indwelling urinary catheter (IUC), mechanical ventilation (MV), surveillance culture and contact precaution, that is, all categories of cultures used by the institution.

We included positive microbiological cultures, collected 72 hours after admission, characterized as healthcare-associated infections (HAIs)[18] of patients who had a nursing prescription for bed bath, for 48 months, from 06/01/2016 to 05/31/2020, in the three selected inpatient units, so that it was possible to consider the three distinct and subsequent periods of experience hospital with the implementation of the three bed bath protocols.

The collected data were entered into an Excel spreadsheet and, before model adjustment, an exploratory analysis was carried out to locate outliers that would deserve revisions.

- (a) Potential confounding variables: spring month (yes/no), summer month (yes/no), autumn month (yes/no), winter month (yes/no); mean age of patients tested in the month (in complete years); percentage of people tested male;
- (b) Independent variable/exposure: bed bath modalities (CBB / DBB / DBB-CX) (Annex 1), identified by the periods that comprised the use of three bed bath protocols, in the hospitalization units: Period 1 (P1) CBB – from June 2016 to May 2017; Period 2 (P2) DBB - from June 2017 to May 2019; Period 3 (P3) DBB-CX, from June 2019 to May 2020;
- (c) Dependent variable/outcome: percentage of microbiological culture positivity of hospitalized patients.
- First, the association of each variable with potential for confounding with the percentage of culture positivity was assessed individually, using simple linear regressions with normal response. Variables associated with $p < 0.10$ were taken to a multiple linear regression model with normal response to explain the percentage of culture positivity as a function of bath modality. The statistical model adjustment adequacy was assessed, investigating residual normality, the presence of heteroscedasticity and non-random relationship between residuals and the temporal order of the observations. In the final model, associations were considered statistically significant if $p < 0.05$. We used SPSS 21 for analysis.

The researchers deny any interference from suppliers of DBB technology at any stage and execution of this research, since it is a public hospital and the inputs obtained are given through public bids.

Data collection was carried out in September 2020 in electronic medical records of patients, after project approval by the Research Ethics Committee (REC), under opinion 4,190,628 and CAAE (*Certificado de Apresentação para Apreciação Ética* - Certificate of Presentation for Ethical Consideration) 35496820.9.0000.5411.

Results

Throughout 48 months, 6,487 patients were admitted to the three inpatient units, 1,853 in medical clinic I, 1,241 in neurology/neurosurgery and 3,393 in gastrosurgery. Of this total, 3,010 had a nursing prescription for bed bath and 858 had positive culture results. Of these results, 457 were considered as HAIs and, therefore, were the research sample.

The medians of patients with positive microbiological cultures decrease in P2 (8.5) and P3 (8.5), as well as the median percentage of culture positivity (P2=27.2%; P3=21.1%). This reduction occurs after the implementation of DBB (P2) and 2% DBB-CX (P3), compared to the highest median (11.5) and the percentage of culture positivity (41.8%) of these cultures in P1, when CBB was still performed. As a result, there was an expected decrease in the medians of cultures collected in P2 (11.0) and P3 (10.5) as well as an increase in the medians of neg-

Table 1. Profile of the sample of microbiological cultures of a patient, with a nursing prescription for bed bath, in three disjoint and sequential periods of 48 months, for conventional bed bath, followed by disposable bed bath and disposable bed bath plus 2% chlorhexidine

	CBB (Period 1: June 2016 to May 2017) n=139					DBB (Period 2: June 2017 to May 2019) n=222					DBB-CX (Period 3: June 2019 to May 2020) n=96				
	med*	q1†	q3‡	min§	max‖	med*	q1†	q3‡	min§	max‖	med*	q1†	q3‡	min§	max‖
Number of patients positive	11.5	10.0	13.8	4.0	19.0	8.5	7.0	11.8	5.0	15.0	8.5	7.0	10.0	2.0	13.0
Number of cultures collected	14.0	11.3	16.8	5.0	27.0	11.0	8.0	13.0	5.0	19.0	10.5	7.3	13.8	2.0	17.0
Number of men tested	5.5	5.0	6.8	4.0	11.0	4.0	3.0	6.0	0.0	10.0	3.5	2.0	5.0	1.0	8.0
Number of women tested	5.5	5.0	7.8	0.0	9.0	5.0	4.0	6.8	2.0	8.0	5.0	2.5	5.8	1.0	6.0
Percentage of men tested	51.9	45.6	58.2	35.7	100.0	50.0	30.8	55.1	0.0	66.7	44.9	35.0	58.7	28.6	75.0
Mean age	62.3	60.1	66.1	55.8	71.8	60.5	58.1	67.6	50.8	73.7	61.1	54.0	64.3	44.4	65.6
Number of negative tests	19.5	18.0	21.8	15.0	34.0	51.0	41.8	67.3	23.0	82.0	53.0	38.8	74.0	18.0	86.0
Number of positive tests	14.5	13.3	18.0	10.0	24.0	20.0	18.0	23.8	6.0	27.0	17.5	8.5	21.0	4.0	29.0
Total tests	34.0	32.0	41.3	25.0	54.0	71.5	62.3	87.5	34.0	102.0	72.5	48.0	92.0	22.0	108.0
Percentage of culture positivity	41.8	39.2	44.0	37.0	53.3	27.2	22.0	33.4	17.6	46.5	21.1	17.6	26.6	14.0	37.1

med* = median; q1† = quartile 1; q3‡ = quartile 3; min§ = minimum median; max‖ = maximum median

ative tests (P1=19.5; P2=51; P3=53) (Table 1). We can consider the sample with a homogeneous median in P1, between females and males (5.5; 5.5), of patients with positive cultures and higher for females in P2 (5.0; 4.0) and P3 (5.0; 3.5) (Table 1). The median age in years of patients with positive microbiological cultures belong to older adults' age group, with little variation between P1 (62.3), P2 (60.5) and P3 (61.1) (Table 1).

Table 2 shows the bivariate associations of each variable with the percentage of culture positivity. It was observed that the variables associated with culture positivity (with $p < 0.10$) were type of bath and mean age of patients. Thus, these variables were included in the multiple linear regression model adjustment, presented in table 3.

Table 2. Bivariate associations to explain the percentage of culture positivity of patients, with nursing prescription for bed bath, in three disjoint and sequential periods of 48 months, for conventional bed bath, followed by disposable bed bath and disposable bed bath plus 2% chlorhexidine

Variables	b(*)	95%CI(†)		p-value‡
Disposable bed bath with chlorhexidine 2% (DBB-CX) (P3)	-20.48	-25.63	-15.33	0.000
Disposable bed bath (DBB) (P2)	-14.87	-19.33	-10.41	0.000
Type of bed bath (Reference: Conventional) (P1)	0[a]			
Spring month	-0.21	-6.72	6.29	0.949
Summer month	1.17	-5.33	7.67	0.725
Autumn month	-0.08	-6.59	6.43	0.981
Winter month	-0.87	-7.38	5.63	0.793
Percentage of men who underwent examination	0.13	-0.03	0.30	0.122
Mean age of patients who underwent examination	0.54	0.07	1.00	0.023

b* =regression coefficient estimate; 95%CI† =95% confidence interval for "b"; p-value‡ = simple linear regression with normal response

In the disposable bath period. the percentage of culture positivity was, on average, 14.6% lower when compared to the months in which bed bath was conventional. In the period of DBB-CX, the percentage of culture positivity was, on average, 19.3% lower when compared to the months of the period in which the bed bath was conventional. However, there is no evidence of difference in the percentage of culture positivity between DBB (b = -14.6%; CI95% = (-18.9% to -10.3%) and DBB-CX (b = - 19.3%; CI95% = (-24.4% to -14.22%). Each year more in patients' mean age, the percentage of culture positivity increased, on average, 0.3% (p=0.060) (Table 3). Furthermore, season months (Figure 1) were not associated with microbiological culture positivity for no bath modality (spring p=0.949, summer p=0.725, autumn p=0.981, winter p=0.793) (Table 3).

Table 3. Multiple linear regression to explain the percentage of culture positivity of patients, with a nursing prescription for bed bath, in three disjoint and sequential periods of 48 months, for conventional bed bath, followed by disposable bed bath and disposable bed bath plus 2% chlorhexidine

Variable	b*	95%CI†		p-value‡
Intercept	23.82	3.60	44.04	0.021
Disposable bed bath with 2% chlorhexidine (DBB-CX) (P3)	-19.34	-24.45	-14.22	0.000
Disposable bed bath (P2)	-14.63	-18.94	-10.31	0.000
Type of bed bath (Reference: Conventional) (CBB) (P1)	0[a]			
Mean age of patients who underwent examination	0.30	-0.01	0.62	0.060

b*=regression coefficient estimate; 95%CI†=95% confidence interval for "b"; p-value‡= multiple regression with normal response

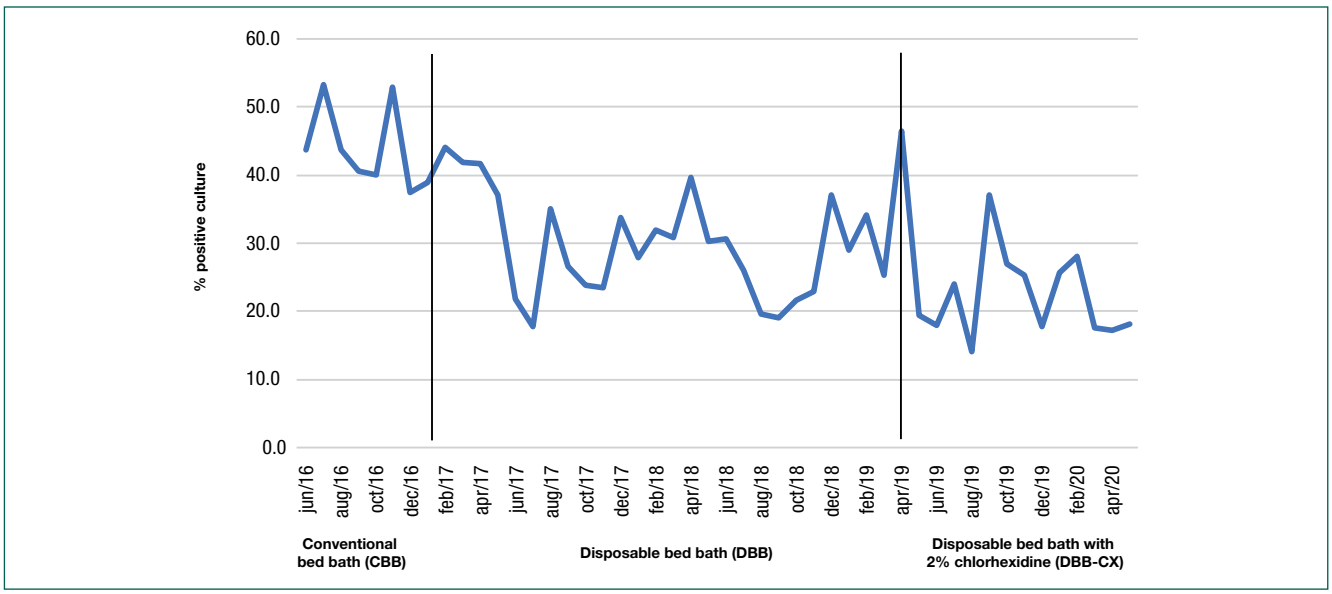

Figure 1. Time series of the percentage of positive microbiological cultures of patients with a nursing prescription for bed bath, in three separate and sequential periods of 48 months, for conventional bed bath, followed by disposable bed bath and disposable bed bath plus 2% chlorhexidine

Discussion

The analysis of the results of this research confirmed the hypothesis that microbiological culture positivity of hospitalized patients is lower when submitted to DBB and DBB-CX, when compared to CBB.

These results support scientific evidence of a clinical trial for BBD efficacy, estimated at 90%, on skin microbial load, while that of CBB was 20%, colonizing 80% of participants, thus confirming the benefit of the product in controlling skin microbial load of hospitalized patients, presuming to contribute as a barrier to the spread of microorganisms in the hospital environment.[7]

Another important research carried out at the same institution assessed the effectiveness of 80% alcohol (w/v) in the reprocessing of stainless-steel basins, and even after washing with neutral soap, rinsing and rubbing with alcohol for 30 and 60 seconds, the basins were if with important pathogens such as *Pseudomonas aeruginosa*, *Proteus mirabilis*, *Enterococcus faecalis* and *Stenotrophomonas maltophilia*, some of them "multidrug-resistant" (MDR).[14]

It was found that research on bed bath is predominantly related to microbiological efficacy studies between DBB-CX and CBB.[19,20] Thus, one of the limitations of this research was to discuss the results, considering the reduced number of studies that assessed the impact on microbiological culture positivity of hospitalized patients for CBB, DBB and 2% DBB-CX. A randomized clinical trial was found, which is cited at the beginning of this discussion.[7]

Thus, the fact that the present study did not identify a statistically significant difference between the DBB modalities, DBB (p = 0.000) and DBB-CX (p = 0.000), signals to nurses and managers that DBB is sufficiently safe as a preventive measure HAIs, without having to adopt 2% DBB-CX as a routine practice.

With satisfaction, it is understood as prudent to reserve a prescription for special care, such as degermation of patients' skin before invasive procedures, preoperative baths, hand hygiene by health professionals,[21] since the inadvertent use of chlorhexidine can contribute to the resistance of microorganisms to the antiseptic,[22] in addition to making the procedure more costly.

Another finding of this research showed that for older adults, with each additional year in average age, the percentage of culture positivity increased, on average, by 0.3% (p=0.060), a fact that indicates this population is more exposed to HAI. Throughout life the skin undergoes constant physiological changes and in its microbiome, these

changes provide older adults with a more ineffective skin barrier, leaving them with greater susceptibility to pathogenic microorganisms.[1,23]

As older adults have a higher percentage of culture positivity, it is suggested that health institutions develop specific protocols for the bed bath procedure, to meet the needs of this age group, with the use of DBB and in the imminence of scarcity of financial resources, currently experienced by numerous health institutions, and in the impossibility of providing DBB to all patients who have the bed bath procedure in the prescription, a careful assessment must be carried out to select and direct, in these cases, the technology to primarily care for older adults.

Climatic seasonality is pointed out as an epidemiological aspect for HAI, changes in temperature and climate can infer the incidence of infections, such as those caused by Gram-negative bacteria, which are more commonly found in the seasons, with higher temperature and humidity.[24,25] In this research, the supposition that seasons are associated with microbiological culture positivity for the three types of bed bath was refuted. However, further research on the object of investigation is suggested.

To reduce HAIs, additional measures should be implemented, such as hand hygiene, proper use of attire to perform sterile procedures, adequate measures of CP and continuing education for the health team, as isolated measures present difficulties to maintain the reduction of HAI.

Efficacy studies, such as a randomized clinical trial, should be carried out to better understand the need to use 2% DBB-CX in HAI prevention, since this study did not show a significant difference in relation to the two types of disposable baths.

This research presented limitations, firstly, the obtaining of data from patients' computerized medical records, a fact that did not allow researchers to carry out on-sight collection and to proceed with the assessment and monitoring of bath procedures. Furthermore, it was carried out in three inpatient units with different characteristics and care complexities.

As for the data analysis to have taken place in three disjoint and sequential periods, however asymmetrical in number of months, being 12, 24 and 12, it was the researchers' decision to safeguard the periods that characterized the real transition between the three modalities of bed bath adopted in the hospital. Additionally, after careful statistical analysis, there was a behavior of the percentage of positive cultures throughout the observation period (P1+P2+P3), suggesting a downward trend for estimated effects (P1>P2) and (P1>P3), which would be maintained, even if periods P1 and P3 were expanded to 24 months, instead of 12. What could change would be the p-value referring to the comparisons between the periods; however, p-values were already very low and any change to reduce them would not bring epidemiological gain even for those responsible for decisions based on the findings.

Finally, this research is unique in nature, contributing to evidence production for clinical nursing to safely meet patients' hygiene and comfort needs, specifically, the possibility of subsidizing nurses for developing f the nursing process in prescribing the bed bath intervention, one of the most performed procedures by nursing, in hospital settings and so little explored in research.

Conclusion

The analysis of the results of this study corroborated the hypothesis that microbiological culture positivity is lower in hospitalized patients undergoing DBB and 2% DBB-CX when compared to CBB. As there was no evidence of difference in the percentage of culture positivity between the disposable baths, corroborating the protective effect for HAIs of DBB, it is suggested to prescribe DBB-CX as an exclusive procedure for degerming patients' skin before invasive procedures, preoperative baths and hand hygiene by the healthcare professional, in order not to contribute to microbial resistance to chlorhexidine. Furthermore, among the bed bath modalities, priority should be given to the prescription of BPD for older adults, since in this age group, with each additional year in the average age, the percentage of culture positivity increases on average by 0.3%. Finally, further studies are suggested to assess the influence of seasons on positive microbiological culture rates, considering the CBB and DBB modalities, as well

as randomized clinical trials to assess the microbiological efficacy between DBB and DBB-CX.

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Collaborations

Paulela DC, Mondelli AL, Bocchi SCM and Nunes HRC declare that they contributed to study design, data analysis and interpretation, article writing, relevant critical review of the intellectual content and approval of the final version to be published.

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Annex 1. Standard Operating Procedures (SOP) for three types of bed bath, used in a public hospital in the state of São Paulo, Brazil, from 06/01/2016 to 05/31/2020

Conventional bed bath, in force in period 1, from 06/01/2016 to 05/31/2017

Materials: procedure gloves, 1 disposable apron, 1 disposable diaper, shower trolley, bucket, basin, bar soap, 1 towel, 3 non-sterile compresses, bottle of body moisturizer, 1 nightgown, 1 pillowcase, 1 lining, 2 sheets, screen and hamper, 70INPM alcohol.

Procedure: sanitize hands; check patient identification; prepare the patients' environment, close doors and windows; position screens and a shower trolley close to the bed; tell patients about the procedure; put warm water in the bucket and basin; put on procedure gloves; unhook the bedding; remove the nightgown protecting patients with a sheet; moisten the compress with warm water; put soap and sanitize the face, ears and neck, with another compress moistened with water, rinse and dry with a towel; wash, rinse and dry the chest; wash, rinse and dry the distal upper limb and axilla; wash, rinse and dry the proximal upper limb and axilla; wash, rinse and dry the distal lower limb and inguinal region; wash, rinse and dry the proximal lower limb and inguinal region; lateralize patients, wash, rinse and dry the dorsal region; lateralize patients, place the bedpan and position in the supine position; wash, rinse and dry the genital region; change procedure gloves; lateralize patients and remove the bedpan; keep patients in lateral recumbency; wash, rinse and dry the patients' back, buttocks and perianal region; push the wet bedding to the middle of the bed, disinfect the mattress with 70% alcohol; moisturize the dorsal region with body moisturizer; arranged the bed with patients in the lateral position; turn patients onto the ready side of the bed; remove dirty clothes and put them in the hamper; disinfect the mattress with 70% alcohol; arrange the bed; put on disposable diaper; moisturize the rest of patients' skin; wear the sweater; proceed with the positioning of patients in bed; forward stainless steel utensils to the purge; throw away the water; discard the compresses in the appropriate garbage; remove gloves; perform hand hygiene; organize the unit; make nursing notes in patients' electronic medical records.

Disposable bed bath, in force in period 2, 06/01/2017 to 05/31/2019

Materials: procedure gloves, 1 disposable apron, 1 disposable diaper, bath trolley, 1 disposable bath bag, 1 nightgown, 1 pillowcase, 1 lining, 2 sheets, screen and hamper, alcohol 70INPM.

Procedure: sanitize hands; check patient identification; prepare the patients' environment, close doors and windows; position screens and a shower trolley close to the bed; tell patients about the procedure; heat the bath bag for 30 seconds in a microwave oven (optional); perform hand hygiene; wear the apron; put on gloves, loosen bedding; remove patients' nightgown, protecting them with a sheet; perform, with the first compress, the cleaning of the face, ears, neck, chest and abdomen; clean, with the second compress, the distal upper limb and armpit; clean, with the third compress, the proximal upper limb and armpit; clean, with the fourth compress, the distal lower limb and inguinal region; with the fifth compress, clean the proximal and inguinal lower limbs; clean the genital region with the sixth compress; lateralize patients and, with the seventh compress, clean the back of patients; clean the buttocks and perianal region with the eighth compress; keep patients lateralized; push the bedding to the middle of the bed; disinfect the mattress with 70% alcohol; make the bed; lateralize patients to the ready side of the bed; remove dirty bedding, placing it in the hamper; disinfect the mattress with 70% alcohol; make the bed; put on the disposable diaper; wear the sweater; position patients properly in bed; remove gloves and sanitize hands; organize the unit; make the nursing note in patients' electronic medical records.

Disposable bed bath plus 2% chlorhexidine, in force from 3/3/2019 to 5/31/2020

Materials: procedure gloves, 1 disposable apron, 1 disposable diaper, bath trolley, 1 disposable bath bag, 1 bath towel, 1 basin of warm water, 4 multipurpose cloths, 1 disposable cup of 50 ml, 30 ml of chlorhexidine 2% degerming agent, 1 nightgown, 1 pillowcase, 1 lining, 2 sheets, screen and hamper, alcohol 70INPM.

Procedure: sanitize hands; check patient identification; prepare the patients' environment; explain the procedure and purpose to patients and/or companions; close doors and windows; put warm water in the basin, filling a third of its total capacity; heat the package of disposable baby wipes in the microwave for 15 to 30 seconds; go to patients' bed, taking the bath trolley and hamper; perform hand hygiene with water and antiseptic soap (minimum 30 seconds) or with alcohol gel (minimum 15 seconds); ask patients and/or companions: "What is your full name?", "What is your date of birth?" "Do you know your hospital registration number?"; check the identification bracelet data with the data perform hand hygiene; opening the package wrapper of heated disposable wipes; lower the bed rails; loosen the bed sheets; reserve the blanket if it is to be reused; remove the pillow and lower the head of the bed. Patients on mechanical ventilation and/or receiving an enteral diet, the headboard should be kept at 30°; perform hand hygiene; put on a surgical mask, safety glasses and disposable apron; perform hand hygiene; put on procedure gloves; remove patients' nightgown, protecting him with a sheet; uncover patients down to the abdomen; detach and lower the disposable diaper, if patients use it; moisten the first disposable multipurpose cloth in warm water and place approximately 10 ml of 2% chlorhexidine degerming agent on it; proceed with cleaning as follows: neck, chest and abdomen, upper limb and armpit; let it act for 2 minutes; cover the sanitized areas with a bath towel to avoid exposure; throw away the multipurpose cloth; moisten the second disposable multipurpose cloth in warm water and place approximately 10 ml of 2% chlorhexidine degerming agent on it; continue cleaning as follows: distal lower limb; proximal lower limb; despise the multipurpose cloth; let it act for 2 minutes; keep the sanitized areas covered with a bath towel to avoid exposure; clean (rinse) with the disposable wet handkerchief for bath as follows: 01 for face, ears, neck, chest and abdomen (discard); 01 for the left upper limb and armpit (discard); 01 for the right upper limb and proximal armpit (discard); 01 for left lower limb (despite); 01 for right lower limb (despite); 01 for genital region (despise); keep the sanitized areas covered with a bath towel, avoiding unnecessary exposure; ask the other nursing team member who is helping with the procedure, to lateralize patients; moisten the third disposable multipurpose cloth in warm water and place approximately 10 ml of 2% chlorhexidine degerming agent on it; cleaning the dorsal and gluteal regions; despise the multipurpose cloth; let it act for 2 minutes; keep the sanitized areas covered with a bath towel to avoid exposure; keep patients in lateral recumbency; roll up and push the soiled sheet and lining to the middle of the bed; cleaning the mattress with the fourth multipurpose cloth soaked in 70INPM alcohol; spread the clean sheet in half of the mattress, so that it covers the exposed part of the mattress and the rest is rolled up, close to patients; extend the liner at the height of the patients' hip; continue cleaning (rinsing) patients, this time with the disposable wet handkerchief for bath in the regions: 01 for dorsal and gluteal, 01 for perianal; lateralize patients on clean sheet and lining; remove the dirty sheet and lining; throw away in the hamper; clean the mattress with the fourth multipurpose cloth soaked in 70INPM alcohol; finish changing the sheet, stretching the edges so that there are no folds and tying the ends; place the disposable diaper according to the technique, if necessary; position patients in the supine position; finish placing the disposable diaper, securing its sides; put the nightgown or pajamas on patients; cover patients with sheet and blanket; throw away the sheet, lining and clothes in the hamper; remove procedure gloves; perform hand hygiene; put on procedure gloves; remove the pillowcase from the pillow, sanitize it with 70INPM alcohol, put a clean pillowcase; comfortably accommodate patients in bed with pillow; lift the bed rails; elevate the headboard by 30 degrees, if there is no contraindication; organize the unit; remove procedure gloves; perform hand hygiene; remove disposable apron, surgical mask; perform hand hygiene; put on procedure gloves; go to the purge with a bath trolley, containing materials to be discarded; dispose of garbage in the appropriate garbage; remove

procedure gloves; perform hand hygiene; put on procedure gloves; perform cleaning of the bath trolley and store it; wash the basin with soap and water, dry, rub 70INPM alcohol for 3 minutes, pack in a plastic bag, put the date and keep it; remove procedure gloves; perform hand hygiene; remove safety glasses, wash them with soap and water, dry them and put them away; check nursing prescription; make nursing notes in the Hospital Information System.