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HAND HYGIENE: ITS EFFECTS ON INFECTION INDICES AND HOSPITAL COSTS HIGIENIZAÇÃO DAS MÃOS: SEUS EFEITOS NOS ÍNDICES DE INFECÇÃO E CUSTOS HOSPITALARES

LAVADO DE MANOS: SUS EFECTOS SOBRE LAS TASAS DE INFECCIÓN Y COSTOS HOSPITALARIOS

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ABSTRACT

Objective: to analyze the relationship between the knowledge of nursing professionals on hand hygiene with an alcohol preparation and the effects of this in infection rates and hospital costs in the ICU of a private hospital. **Method:** an exploratory study of quasi-experimental design with a quantitative approach, in which we measured the knowledge of 32 nursing professionals, and correlated this knowledge with hospital infection rates and hospital costs. **Results:** revealed that professionals have adequate knowledge about hygiene, even before the educational intervention, but only the bloodstream infections associated with a central catheter significantly reduced ($p < 0,000$). **Conclusion:** nursing professionals have adequate knowledge about hand hygiene, however, there was no positive relationship between this and the urinary tract infection rates, pneumonia associated with mechanical ventilation and hospital costs after the educational intervention. **Descriptors:** Hand Hygiene; Nosocomial Infection; Nursing Staff.

RESUMO

Objetivo: analisar a relação entre o conhecimento dos profissionais de enfermagem sobre a higienização das mãos com preparação alcoólica e os efeitos desta nas taxas de infecção e custo hospitalar na UTI de um hospital privado. **Método:** estudo exploratório, de desenho quase experimental, com abordagem quantitativa, em que foi mensurado o conhecimento de 32 profissionais de enfermagem e correlacionado este conhecimento com as taxas de infecção hospitalar e os custos hospitalares. **Resultados:** revelaram que os profissionais têm conhecimento adequado sobre higienização, mesmo antes das intervenções educativas, porém, somente as infecções de corrente sanguínea associadas ao cateter central reduziram significativamente ($p < 0,000$). **Conclusão:** os profissionais de enfermagem têm conhecimento adequado sobre a higienização das mãos, no entanto, não houve relação positiva entre este e as taxas de infecção do trato urinário, pneumonia associada à ventilação mecânica e custo hospitalar após a intervenção educativa. **Descritores:** Higiene das Mãos; Infecção Hospitalar; Equipe de Enfermagem.

RESUMEN

Objetivo: analizar la relación entre el conocimiento de los profesionales de enfermería sobre el lavado de manos con alcohol y los efectos de esta preparación sobre las tasas de infección y costo hospitalario en cuidados intensivos de un privado hospital. **Método:** estudio exploratorio, el diseño cuasi-experimental, con un enfoque cuantitativo, en el que fue mensurado el conocimiento de 32 profesionales de enfermería y este conocimiento se correlacionó con las tasas de infección del hospital y los costos hospitalarios. **Resultados:** se demostró que los profesionales tienen conocimientos adecuados sobre higienización, incluso antes de las intervenciones educativas, sin embargo, sólo las infecciones del torrente sanguíneo asociadas a línea central sufrieron significativa reducción ($0,000 <$). **Conclusión:** los profesionales de enfermería tienen conocimientos suficientes sobre el lavado de manos, sin embargo, no hubo ninguna relación positiva entre ésta y las tasas de infecciones del tracto urinario, neumonía asociado ventilación mecánica y a los costos hospitalarios después de la intervención educativa. **Descriptores:** Higiene de las Manos; Infección Nosocomial; Personal de Enfermería.

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INTRODUCTION

Infections Related to Health Care (IRHC) are undesirable outcomes of hospital treatment or basic care not connected to the original health condition of the patient. The HCI can be caused by microorganisms already present in the skin and mucosa of the patient (endogenous) or microorganisms transmitted from another patient, healthcare professional or by the surrounding environment (exogenous). In most cases, the hands of health care professionals are the vehicle for the transmission of microorganisms from the source to the patient. Studies have shown irrefutable evidence that hand hygiene (HH) with alcoholic preparation reduces the microbial load of hands and can replace hand washing with water and liquid soap when the hands are not visibly soiled, but its membership has been little effective.¹⁻²

Despite the high incidence of HCIs, most are preventable. Anchored in this perspective, the World Health Organization (WHO) launched in October 2004, the World Alliance for Patient Safety, a program that has priority, HH with alcoholic preparation simple strategy, low cost and based on sound scientific evidence. However, the main barrier is the low compliance by health professionals regardless of available resources.²⁻³

The WHO recommends that when the cleaning is in accordance with the careful flow, preventing cross-transmission of microorganisms. The five moments for hand hygiene are: before touching a patient; before performing clean/aseptic procedures; when there is risk of exposure to body fluids; after touching the patient and after touching surfaces near the patient.^{1,3}

The technical hands should be rubbed with an alcohol preparation under the gel form, foam and other (final concentration at least 70%) or in liquid form (in final concentration between 60% and 80%). The rubbing of hands must have a duration of at least 20 to 30 seconds. It is noteworthy that the hands cannot be visibly dirty, since alcoholic preparation does not remove dirt.³⁻⁴

The IRHC are not the major cause of mortality, but continue to be a major cause, second only to cardiovascular disease, and is one of the main problems of patients in Intensive Care Units (ICUs). Intensive therapy arose from the need to provide advanced life support to acutely ill patients, but still with a chance to survive. It is a hospital of high complexity, reserved and unique, and aims to

establish full monitoring and surveillance for 24 hours.⁴

In light of the exposed problem, and considering the importance of discussing the knowledge of nursing professionals on hand hygiene with an alcohol preparation as a condition *sine qua non* for the prevention and control of HCI, the study is justified and aims to analyze the relationship between the knowledge of nursing professionals on hand hygiene with an alcohol preparation and the effects of these infection rates and hospital costs in the ICU of a private hospital.

METHOD

An exploratory study of quasi-experimental design with a quantitative approach carried out in a general ICU of a private hospital, involving 42 employees of nursing, from the three shifts.

A data collection instrument was prepared, following the recommendation of the WHO and MS and adapted for this scientific research. In March 2014, the first phase of the survey was conducted, these professionals were asked individually to answer it. Those who agreed to participate signed a free and informed consent (IC), considering the link with the ICU, as an inclusion criterion. In the second phase of the research data was collected from Urinary Tract Infection rates (UTI), pneumonia associated with mechanical ventilation (VAP) and blood stream associated with central catheter (CRBSI) for the months of January and February 2014, together with CCIH to the institution.

In the same period it is collected by the pharmacy service, the real amounts spent with broad-spectrum antibiotics most commonly used in the ICU in January and February 2014. For the choice of antibiotics, we took into account the bibliographic reference, which speaks of the main broad-spectrum antibiotics used at the time in the ICU, namely: tygacil®, moramax®, imipenem / cilastina®, piperacillin / tozobactam® polimixina® vancomicina®.

In the third phase educational intervention was carried out on the importance and how to proceed to hand hygiene, using the five steps. This intervention took the form of lectures in April 2014, at the institution's auditorium, at night, time chosen by most employees.

The fourth and final phase was held in August 2014, when the data was collected on hospital costs, infection rates for the months of June and July 2014 and again applied the questionnaire on the knowledge of the nursing staff on hand hygiene for later comparison.

Data was entered in Excel 2010 and analyzed using the application "SPSS version 18.0" and the results were shown in tables. Having the data analyzed, were performed univariate socio-demographic data, and bivariate analysis of knowledge, infection rates and hospital costs. To check whether there was a statistical variation in the variable knowledge before and after the intervention, we used Pearson's chi-square test. And, to see if there was a variation in hospital costs and infection rates before and after the educational intervention, we used the Wilcoxon test.

Data on knowledge, costs and hospital infection rates were taken as dependent variables, and educational interventions, as an independent variable. For all statistical tests was considered a significance level of 5% ($p < 0.05$).

The study design was approved by the Research Ethics Committee of the Faculty of Health, Human Sciences and Technology of

Piauí (NOVAFAPI), with the CAAE number - 0108.0.043.000-11.

RESULTS

In univariate analysis, we present the characterization of the study population and the distribution of professionals, according to the profession, the number of jobs and the working time in the ICU.

Of the total of 42 employees working in the ICU studied, only 32 answered the questionnaire in the pre and post-intervention. The other 10 employees did not meet the inclusion criteria. Two were on vacation, four were off, two on medical license, a pregnancy license, and wished not to reply to the questionnaire.

Table 1 shows that 84.4% of employees were nursing technicians. 62.5% were aged between 26 and 40 years, with an average of 29.71 years old (SD: 10.10). As for the number of jobs, 53.1% had two jobs, and 32.25%, worked in the ICU less than two years.

Table 1. Characteristics of the study subjects about the profession, number of jobs, working in ICU -Teresina-Piauí, 2014.

Variables	n	%
Total	32	100
Profession		
Nurse	05	15,6
Nursing Technician	27	84,4
Number of Jobs		
04 jobs	01	3,1
03 jobs	02	6,3
02 jobs	17	53,1
01 jobs	12	37,5
Time working at the ICU		
>2 years	10	31,25
3-5 years	09	28,12
6-10 years	05	15,62
>10 years	08	25,00

In the bivariate analysis knowledge of health professionals on hand hygiene with an alcohol preparation was assessed, and its relationship with hospital costs and hospital infection rates before and after the educational intervention.

In this subsection, we proceed to the presentation of categorization referring to the knowledge of the nursing staff related to hand hygiene with an alcohol preparation.

He asked the professionals if there was any alcohol preparation available for hand hygiene at their institution. Table 2 showed that 12.1% responded that "there was no alcohol in preparation service." Despite not having been detected statistically significant differences ($p = 0.66$) after the educational interventions, this number was reduced to 9.4%.

Table 2. Knowledge of nursing professionals about the existence of alcoholic preparation for hand hygiene in the institution before and after the educational intervention, Teresina-Piauí, 2014.

Periods	Existing Alcoholic Preparation		p*
	YES (%)	NO (%)	
Before	87,9	12,1	0,66
After	90,6	9,4	

* chi-square test for linear trend (X2) $P < 0.05$ (significant).

Table 3 shows that most professionals (90.6%) knew even before the educational intervention, that the hands, when not cleaned, are a source of cross-infection, and

this perception has increased significantly ($p = 0.03$) after the interventions 93.9%.

About cleaning technique, the table showed us that 50% said that the hands do not

need to be dry in time to apply the alcoholic preparation. As for the minimum required time, there was no significant change from the previous and subsequent knowledge to interventions ($p = 0,390$), however, it is clear that, after the intervention, was not clarified this action because the answers they are roughly equal between 10 seconds (25%) 20 seconds (28.1%) and 1 minute (28.1%).

Table 3. Knowledge of nursing professionals on hand hygiene technique with an alcohol preparation and minimum time required for the destruction of most microorganisms from the hands before and after the educational intervention, Teresina, Piauí, 2014.

Affirmations		Periods		p [*]
		Before (%)	After (%)	
1. The alcoholic preparation should cover the entire surface of both hands	True	81,8	81,2	0,31
	False	18,2	18,8	0
2. The hands must be dry before cleaning	True	46,9	50,0	0,46
	False	53,1	50,0	5
3. One can dry hands with a towel after rubbing hands with an alcohol preparation.	True	9,1	5,1	0,74
	False	90,9	94,9	4
The minimum time required for the destruction of most of the microorganisms in the hands				
03 seconds		12,1	18,8	
10 seconds		24,2	25,0	0,39
20 seconds		9,1	28,1	0
01 minute		54,5	28,1	

Source: Prepared by.
* Chi-square test for linear trend (X2) $P < 0.05$ (significant).

Table 4 shows the values of urinary tract infection rates of the blood stream associated with central catheter and pneumonia associated with mechanical ventilation before and after the educational intervention. The rate of urinary tract infections and pneumonia associated with mechanical ventilation increased after the interventions. However the rate of bloodstream infection associated with central catheter decreased, with a statistically significant difference ($p < 0.001$).

Table 4. Description of the ITU, VAP, ICRC and the result of the statistical significance test before and after the educational intervention, Teresina-Piauí, 2014.

Number of infections per 1,000 device days (%)					
Infection	Before		After		p [*]
	January	February	June	July	
ITU	16,04	17,04	21,98	36,03	0,181
VAP	30,53	9,34	26,31	41,09	0,655
ICRC	7,57	8,00	0,0	0,0	0,000*

Source: Database CCIH.
* Wilcoxon test. $P < 0.05$ (significant).

The appreciation of Table 5 shows that the overall costs increased after the intervention, however, statically, the increase was not significant $P > 0,807$. Judging each item, it is observed that there was only reduced use of polimixina® and the moramax 2g®.

Table 5. Description of costs (Real) with the main antibiotics and the result of the statistical significance test before and after the educational intervention, Teresina-Piauí, 2014.

Medication	Periods				Diference (R\$)	p
	Before		After			
	January (R\$)	February (R\$)	June (R\$)	July (R\$)		
Tygacil® 50 mg	11.621,98	1.803, 411	2.805, 306	23.845,1	13.225,01	
Polimixina®inj (amp 500.000 iu)	10.739,52	8.278,38	2.386,56	3.878,16	12.753,18	
Piperacilina/tozobactam®inj (fa-4g+0,5mg)	9.077,31	13.753,5	15.862,37	11.277,87	4.309,43	0,807
Imipenem/cilastatin®inj (fr-500mg)	12.320,38	4.565,42	8.630,52	12.508,0	4.252,72	
Moramax 2g®	30.896,85	15.309,25	16.979,35	28.670,05	556,70	
Vancomicina®inj (fa 500 mg)	779, 112	2.467, 188	2.423, 904	1.947,78	2.422,605	
Total (R\$)	121.612,29		131.215,0		9.602,7	

Source: Pharmacy Services.
* Wilcoxon test. P <0.05 (significant).

DISCUSSION

The data in table 1 shows that the participants can be characterized as young adults, phase of life marked by the active economic activity greater social productivity. As for the ratio of nurses and technicians, the observed rates were 15.2% and 84.4%, respectively.

In line with these results, Brazilian studies show that nursing technicians teams represent the highest percentage of professionals in direct and uninterrupted care for the critical patient in most public and private institutions of the country, a reality that goes against the law regulates the practice of nursing, according to which states that it is exclusively the nurse performing the direct nursing care to patients at life risk.⁴

The non-investment professionals with better skills can be harmful to patients. In this sense, a great work done in the US, observational retrospective design involving 197,961 admissions and 176,696 nursing shifts of 8 hours each, in 43 hospitals, found that there was a statistically significant association (P <0 .001) between the amount of nurses and patient mortality. That is, the smaller the number of professionals, the greater the mortality.⁶⁻⁷

Regarding the practice, practitioners had between 2 and 3 years of experience in the ICU. In this sense, a survey assessed the level of knowledge and practices on disinfection procedures among nurses in Italian hospitals. In the study, it was found that only 29% of the nurses recognized the urinary and respiratory tract as the most common, and this recognition was higher in professionals with higher education.⁸

In regards to the number of jobs, we have here two major biases that concern everyone when it comes to patient safety. The first is about the nursing workers in Brazil, little

known and poorly paid, despite being the category that spends most time with the patient. The second bias has an intrinsic relationship with the first, because the employee with an overload of hours worked has lower concentration and consequent impairment of its performance before patients, especially the critics, who demand total attention.⁶⁻⁷

Regarding knowledge, nursing professionals, even before the educational intervention, knew of alcoholic preparation in the ICU, and only 12.1% of subjects responded that there was no alcoholic preparation for hand hygiene, a percentage that has reduced after educational interventions, to 9.4%.

Even with this small percentage, it wonders how being the continuing education of professionals and, especially, as has been the understanding of these to this theme, since the devices were next to each bed and the main traffic locations within the ICU.

Referentially to the continuing education of health professionals, WHO advises that they are informed in a clear and comprehensive manner about the importance of hand hygiene. For that health managers need to organize a plan of action involving the training and evaluation of staff. The evaluation of hand hygiene and perception and knowledge is a vital element of the strategy to improve this practice.⁹

As for technique, analyzed professionals answered correctly in stating that the alcoholic preparation should cover the entire hand and you cannot use the paper towel. However, they showed doubts when asked if hands should or not be dry before applying the alcohol preparation which was shown as 53.1% answered the question incorrectly. After the educational intervention, and the percentage decreased to 50%.

Research shows that the main HH failure of the problem is not the lack of good products,

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but the neglect of this practice. Therefore, it is not enough to adhere to the practice, but do it completely, that is, at the right time in the right place and with the right technique, or there will be no effective reduction of the microbiota contaminated hands.¹⁰

For this reason, WHO manuals, CDC and ANVISA explain that hands must be completely dry before applying the product; placing a sufficient amount to cover all surfaces of the hands; rub until dry and do not use paper towels.^{3-4,11}

Another item on the technique is the minimum time that alcohol should be on hand to destroy microorganisms. Again professionals have proved equivocal since the responses indicated in Table 6 were practically the same, even after intervention within 10 seconds (25%) 20 seconds (28.1%) and 1 minute (28.1%).^{4,11}

It is interesting to note that the activities *in vivo* and *in vitro* of alcohols against vegetative Gram-positive and Gram-negative bacteria, including multidrug-resistant pathogens such as methicillin-resistant staphylococcus aureus (MRSA) and vancomycin-resistant Enterococci (VRE), Mycobacterium tuberculosis and various fungi are unquestionable. However, this activity may decrease depending on its concentration, temperature and exposure time of the pathogen to alcohol. These results suggested that the minimum time is between 20 and 30 segundos.^{4,12}

At the end of the analysis of knowledge, it is summarized that professionals have adequate knowledge, since studies show a percentage of correct answers more than 75%. A similar conclusion was reported by other authors.¹³⁻¹⁴

Each year in the US about two million patients suffer from HI, generating a total cost of between 280 million and 45 billion dollars. The overload is so great to the American health care system, since 1 October 2008 is not reimbursed to hospital costs, urinary tract infection, pneumonia associated with mechanical ventilation, and blood stream. The law was prompted by a perception that hospitals were not implementing simple and inexpensive solutions such as HH, to prevent HI. After these and other political changes that have occurred in this and other industrialized countries, infection rates decreased.¹⁵

Unfortunately it is not what has occurred in developing countries, where less than 5% of the gross national product is spent on health care and the density of the workforce is less

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than five thousand inhabitants. In this scenario, not only HI rates are alarming, but also the effects on the patient and the health system.¹⁶ Thus, in relation to nosocomial infections, the results showed a quite complex scenario, because although the employee knowledge it was considered appropriate by the numbers shown to the right of the previous tables, urinary tract infection rates and pneumonia associated with mechanical ventilation increased to 36.3% and 41.9%, respectively. However, the difference before and after the educational intervention, was not statistically significant.

Another work from April 2003 to February 2006, in five ICUs, three hospitals in Sao Paulo, Porto Alegre and Rio de Janeiro, showed the following rates per one thousand days: urinary tract infection rate (9.6%), ventilator-associated pneumonia (20.9%) and bloodstream infection (9.1%).¹⁷

A study shows that the team even being driven does not perform hand hygiene before procedures, increased with it the risk of infection to the critically ill patients.¹⁸ But the results were not all negative, because the bloodstream infection rates associated the central catheter decreased from 7.57% in January and 8% in February to 0% within two months evaluated, a significant reduction, $p = 0.000$.

This result corroborates a study conducted in Switzerland, published in 2009, which concluded that the rates of bloodstream infection associated with central venous catheters, improved after educational activities on hand hygiene.¹⁹

As for the hospital costs, the cost of broad-spectrum antibiotics increased in the post-intervention period and, despite not being significant, these numbers were expected, while infection rates have risen. These results corroborate what the literature has reported that infections increase spending on patients, are prescribed for most high cost of antibiotics.^{15,20}

CONCLUSION

At the end of the study it was found that the subjects of the survey, 84.4% were nursing technicians, 53.1% have two jobs and 28.2% work in the ICU between 3 and 5 years. Nursing professionals have adequate knowledge about hand hygiene, however, there was no positive relationship between this and urinary tract infection rates, pneumonia associated with mechanical ventilation and hospital costs after the educational intervention.

It is believed that the promotion of continuing education on hand hygiene should be a permanent focus on health services for the control of nosocomial infections, and that the responsibility for such, should not only be taken by the Hospital Infection Control Commission and, yes, by all professionals who are part of the institution's staff. Thus, it is suggested that more research be carried out now using multimodal and a control group for educational methods to better observe the effect of these interventions.

REFERENCES

1. Abramczyk ML. Infecção Hospitalar em Unidades de Terapia Intensiva Pediátrica e Neonatal. In: Associação de Medicina Intensiva Brasileira, organizadora. PROAMI: Programa de Atualização em Medicina: Ciclo 5: modulo 1. São Paulo: AMIB; 2007. p. 9-97.
2. Ministério da Saúde (BR), Agência Nacional de Vigilância Sanitária. Resolução RDC n. 42, de 25 de outubro de 2010: dispõe sobre a obrigatoriedade de disponibilização de preparação alcoólica para fricção antisséptica das mãos, pelos serviços de saúde do País, e dá outras providências [Internet]. Brasília: Ministério da Saúde; 2010 [cited 2015 Jan 12]. Available from: http://bvsms.saude.gov.br/bvs/saudelegis/anvisa/2010/res0042_25_10_2010.html
3. Starling CCD, Leite CASC, Felicio JCS, Ricarte MNG, Cotta MTA, Oliveira MTC, elaboradores. Salve Vidas: higienize suas mãos: higienização das mãos em serviços de saúde [Internet]. Belo Horizonte: Prefeitura de Belo Horizonte; 2015 [cited 2015 Mar 12]. Available from: <http://portalpbh.pbh.gov.br/pbh/ecp/files.d.o?evento=download&urlArqPlc=cartilha-higienizacao-das-maos-em-servicos-de-saude-comcira.pdf>
4. Ministério da Saúde (BR), Agência Nacional de Vigilância Sanitária. Segurança do Paciente em Serviços de Saúde: higienização das mãos [Internet]. Brasília: Ministério da Saúde; 2009 [cited 2015 Jan 12]. Available from: http://bvsms.saude.gov.br/bvs/publicacoes/seguranca_paciente_servicos_saude_higienizacao_maos.pdf
5. Campbell DT, Stanley JC. Delineamentos experimentais e quase experimentais de pesquisa. São Paulo: EPU; 1979.
6. Neves ZCP, Tipple AFV, Souza ACS, Pereira MS, Melo DS, Ferreira LR. Higienização das mãos: o impacto de estratégias de incentivo à adesão entre profissionais de saúde de uma unidade de terapia intensiva neonatal. Rev latinoam enferm [Internet]. 2006 July/Aug [cited 2014 June 17];14(4): 546-52. Available from: http://www.scielo.br/pdf/rlae/v14n4/pt_v14n4a12.pdf
7. Coelho MS, Silva AC, Faria SSM. Higiene de manos como estrategia fundamental en el control de infección hospitalaria: un estudio cuantitativo. Enferm glob [Internet]. 2011 Jan [cited 2014 June 18];10(21): Available from: <http://revistas.um.es/eglobal/article/view/115161/109981>
8. Needleman J, Buerhaus P, Pankratz VS, Leibson CL, Stevens, SR, Harris, M. Nurse staffing and inpatient hospital mortality. N Engl J Med [Internet]. 2011 [cited 2014 June 16];364(11):1037-45. Available from: <http://www.nejm.org/doi/pdf/10.1056/NEJMs1001025>
9. World Health Organization. Guide to implementation: a guide to the implementation of the WHO multimodal hand hygiene improvement strategy [Internet]. Geneva: WHO; 2009 [cited 2011 Dec 09]. Available from: http://www.who.int/gpsc/5may/Guide_to_Implementation.pdf
10. Larson EL. Special problems in antisepsis. In: Rutala WA, editor. Disinfection, sterilization and antisepsis: principles, practices, challenges and new research. Washington: Association for Professionals in Infection Control and Epidemiology; 2004. p. 104-6.
11. Centers for Disease Control and Prevention. Guideline for hand hygiene in health-care settings: recommendations of the healthcare infection control practices advisory committee and the HICPAC/SHEA/ APIC/IDSA hand hygiene task force. MMWR [Internet]. 2002 Oct [cited 2015 Jan 21];51(RR-16):1-54. Disponível em: <http://www.cdc.gov/mmwr/pdf/rr/rr5116.pdf>
12. Calil K, Cavalcanti VGS, Silvino ZR. Ações e/ou intervenções de enfermagem para prevenção de infecções hospitalares em pacientes gravemente enfermos: uma revisão integrativa. Enferm glob. [Internet]. 2014 Apr [cited 2015 Mar 08];13(34):406-24. Available from: <http://revistas.um.es/eglobal/article/download/156491/160771>
13. Rykkje L, Heggelund A, Harthug S. Enkle tiltak gir bedre handhygiene. Tidsskr Nor Lægeforen [Internet]. 2007 Mar [cited 2015 Jan 25];127(7):861-3. Available from: <http://tidsskriftet.no/pdf/pdf2007/861-3.pdf>
14. Sjöberg M, Eriksson M. Hand disinfectant practice: the impact of an education

Intervention. Open Nurs J [Internet]. 2010 [cited 2015 Jan 15];4:20-24. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866238/pdf/TONURSJ-4-20.pdf>

15. Graves N, Harbarth S, Beyersmann J, Barnett A, Halton K, Cooper B. Estimating the cost of health care-associated infections: mind your p's and q's. Clin Infect Dis [Internet]. 2010 Apr [cited 2015 Jan 23];50(7):1017-21. Available from: <http://cid.oxfordjournals.org/content/50/7/1017.full.pdf+html>

16. Allegranzi B, Nejad SB, Combescure C, Graafmans W, Attar H, Donaldson L, Pittet D. Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis. Lancet. 2011 Jan;377(9761):228-41. (IMPRESSO).

17. Salomao R, Rosenthal VD, Grimberg G, Nouer S, Blecher, Buchner-Ferreira S, et al. Device-associated infection rates in intensive care units of Brazilian hospitals: findings of the International Nosocomial Infection Control Consortium. Rev Panam Salud Publica [Internet]. 2008 Sept [cited 2014 June 18];24(3):195-202. Available from: <http://www.scielosp.org/pdf/rpsp/v24n3/a06v24n3.pdf>

18. Xavier C, Carmo A, Korinfsky J, Nunes G, Silva R, Mendes R. Enfermagem na assistência ventilatória: análise da aspiração endotraqueal na unidade de terapia intensiva. Rev enferm UFPE on line [Internet]. 2013 Dec [cited 2015 Jan 12];7(12):6800-7. Available from: http://www.revista.ufpe.br/revistaenfermagem/index.php/revista/article/viewFile/3323/pdf_4110

19. Vandijck DM, Labeau S, Brusselaers N, De Wandel D, Vogelaers DP. Impact of a prevention strategy targeting hand hygiene and catheter care on the incidence of catheter-related bloodstream infections. Crit Care Med. 2009 Nov;37(11):2998-99. (IMPRESSO)

20. Neyra RC, Frisancho JA, Rinsky JL, Resnick C, Carroll KC, Rule AM, Ross T, et al. Multidrug-resistant and methicillin-resistant staphylococcus aureus (MRSA) in hog slaughter and processing plant workers and their community in North Carolina (USA). Environ Health Perspect [Internet]. 2014 May [cited 2015 Jan 16];122(5):471-7. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/pmid/24508836/>

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