Reduction of nosocomial infections and mortality attributable to nosocomial infections in pediatric intensive care units in Lithuania

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Key words: *nosocomial infection; pediatric intensive care; incidence rate; risk; mortality.*

Summary. *Objective. The aim of the study was to identify the most important risk factors for nosocomial infections, evaluate the incidence rates and risk changes after the multimodal intervention, and to assess mortality attributable to nosocomial infections.*

Material and methods. This was a prospective surveillance study. Data were collected from January 2005 until December 2007 in three pediatric intensive care units. All patients aged between 1 month and 18 years hospitalized in units for more than 48 hours were included in the study. The patients were divided into preintervention (2006) and postintervention (2007) groups. The multimodal intervention included education of the staff and implementation of evidence-based infection control measures.

Results. A total of 755 children were included in the study. Major risk factors for nosocomial infections were identified: mechanical ventilation, central line, intracranial pressure device, and tracheostomy. Overall, the incidence rate (15.6 vs. 7.5 cases per 100 patients, P=0.002), incidence density (19.1 vs. 10.4 cases per 1000 patient-days, P=0.015), and the incidence of pneumonia (5.6 vs. 1.9 per 100 patients, P=0.016) have decreased in the postintervention as compared with the preintervention group. The relative risk reduction, absolute risk reduction, and number needed to treat were statistically significant for ventilator-associated pneumonia (66.5%, 3.7%, 27, respectively; P=0.016). There was no significant difference in survival time by the presence of nosocomial infection (83.67 patient-days without vs. 74.33 patient-days with infection, P>0.05)

Conclusions. The most important risk factors for nosocomial infections were mechanical ventilation, central line, intracranial pressure device, and tracheostomy. After the multimodal intervention, there was a statistically significant decrease in the incidence rates of nosocomial infections and the risk reduction for ventilator-associated pneumonia. No significant impact of nosocomial infections on mortality was determined.

Introduction

Nosocomial infections (NIs) are a significant problem resulting in socioeconomic burden; also, it is a preventable problem on average. Incidence rate of NIs ranges from 4% to 10% in hospitals and from 6.1% to 23.6% in pediatric intensive care units (ICUs), and it is associated with a high number of deaths and increased direct costs through an increase in hospital stays and development of resistant bacteria (1–7). Children are even more susceptible to NIs, because of additional risk factors (3, 7–9). The risk reduction using a stepwise approach can be successful in infection prevention and can reduce the NI incidence rates in pediatric ICUs (10, 11). In addition, the accurate evaluation of NI-associated attributable mortality is substantial. Using survival analysis methods rather than logistic regression allows us to avoid time-dependent bias and overestimation of an attributable mortality (12, 13).

The aim of the study was to identify the most important risk factors for acquiring an NI, to evaluate the NI incidence rates and risk changes after the multimodal intervention, and to assess mortality attributable to NIs in pediatric ICUs in Lithuania.

Materials and methods

Clinical data were collected prospectively from January 2005 until December 2007 in three pediatric

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ICUs (the Hospital of Kaunas University of Medicine [2005–2007], Klaipėda Children's Hospital and Šiauliai Hospital [(2006–2007]). All three units participated in the study and submitted the data on a voluntary basis. The study was approved by the Lithuanian Bioethics Committee.

This was a prospective surveillance study. All patients aged between 1 month and 18 years hospitalized in pediatric ICUs for more than 48 hours were eligible for inclusion in the study.

Patient-based NI surveillance protocol adapted from the Hospitals in Europe Link for Infection Control through Surveillance (HELICS) was used (14, 15). Patients in the units were assessed by physicians on duty, and standard data collection form was filled out. The variables included admission date, gender, age, referral place, clinical profile (medical, surgical, burns), trauma (yes/no), Pediatric Index of Mortality (PIM2), patient status on admission (presence of infection, antibiotics at the time of admission, surgical operation within 1 month before admission), risk factors (endotracheal tube/mechanical ventilation, central venous catheter (i.e. central line), urinary catheter, peripheral arterial/venous catheter, intracranial pressure (ICP) device, bronchoscopy, tracheostomy, feeding tube, drain in a sterile cavity, antacids), NI diagnosed, date of the NI, secondary bacteremia, antimicrobials prescribed, pathogens found, outcome (discharge, death), and outcome date. PIM2 score in this study was used as additional tool for prediction of the mortality depending on the underlying pathology and status of the patients on admission during the first hour of contact with the ICU physician (16–20).

Standard Centers for Disease Control and Prevention definitions of NIs were used (21). An infection was defined as an NI if it occurred 48 hours after admission to the unit.

According to the design of the study, all the patients were divided into two groups: preintervention group (i.e. controls) – before the intervention (2006), postintervention group – after completion of the intervention (2007).

The multimodal intervention (i.e. an infection control program) was designed depending on the NI surveillance data analysis in the control group and the data gathered from the evaluation form of NI prevention methods. The intervention included education of the ICU staff (6 hours) about NI prevention and implementation or correction of daily routine procedures, according to the evidence-based recommendations (Table 1) (22–24). The overall compliance with the evidence-based recommendations was checked using the evaluation form of NI prevention methods, which was filled out in each unit at the beginning of the study and after the completion of the intervention. Neither organizational structure of the ICUs nor the staff has changed during the study period.

The most important risk factors for acquiring an NI were identified in the preintervention group. The pre- and postintervention groups were checked for their homogeneity by gender, age, referral place, clinical profile, presence of trauma, PIM2 score, length of stay, and number of patients with endotracheal tube/mechanical ventilation, with central venous catheter, and with urinary catheter placement. The NI incidence (number of NIs divided by number of admitted patients), incidence density (number of NIs divided by number of patient-days), incidence by site of infection (number of NIs by site divided by number of admitted patients), device-associated rate (number of NI divided by number of device-days), mortality rate (number of dead patients divided by number of

Table 1. **Description of the multimodal intervention measures in pediatric intensive care units**

Prevention of ventilator-associated pneumonia
• Emphasize hand washing for ICU staff, consultants and parents
• Educate health care workers about the epidemiology of, and infection-control procedures, for preventing health care-associated pneumonia and involve the workers in the implementation of interventions to prevent health care-associated pneumonia
• Do not change routinely, on the basis of duration of use, the breathing circuit that is in use on an individual patient. Change the circuit when it is visibly soiled of mechanically malfunctioning
• Periodically drain and discard any condensate that collects in the tubing of a mechanical ventilator, taking precautions do not allow condensate to drain toward the patient
• Wear gloves to perform the previous procedure and/or handling the fluid
• Before deflating the cuff of an endotracheal tube in preparation for tube removal, or before moving tube, ensure that secretions are cleared from above the tube cuff

Table 1. **Continuation**

• As soon as the clinical indications for their use are resolved, remove devices such as endotracheal, tracheostomy, and/or enteral tubes from the patients • In the absence of medical contraindications, elevate at an angle of 30–45° of the head of the bed of a patient at high risk for aspiration (e.g. receiving mechanical ventilation and/or who has enteral tube in place) • Routinely verify appropriate placement of the feeding tube • Do not use antacids routinely for mechanically ventilated patients • As much as possible, avoid repeat endotracheal intubation in patients who have received mechanical ventilation • Oropharyngeal cleaning and decontamination with an antiseptic agent for patients in acute-care settings or residents in long term care facilities who are at high risk for health care-associated pneumonia • Implementation of oropharyngeal cleaning and decontamination according to established protocol (with toothbrush) for intubated patients
Prevention of bloodstream infection • Emphasize hand washing for ICU staff, consultants, and parents • Use only single use towels in the ICU • Educate health-care workers regarding the indications for intravascular catheter use, proper procedures for the insertion and maintenance of intravascular catheters, and appropriate infection control measures to prevent intravascular catheter-related infections • Use of gloves does not obviate the need for hand hygiene • Record the operator, date, and time of catheter insertion and removal, and dressing changes on a standardized form • Observe hand hygiene before and after palpating catheter insertion sites, as well as before and after inserting, replacing, accessing, repairing, or dressing an intravascular catheter • Encourage patients to report to their health care provider any changes in their catheter site or any new discomfort • Maintain aseptic technique for the insertion and care of intravascular catheters • Wearing clean gloves rather than sterile gloves is acceptable for the insertion of peripheral intravascular catheters if the access site is not touched after the application of skin antiseptics. Sterile gloves should be worn for the insertion of arterial and central catheters • Wear clean or sterile gloves when changing the dressing on intravascular catheters • Do not routinely use arterial or venous cutdown procedures as a method to insert catheters • Leave peripheral venous catheters in place in children until IV therapy is completed, unless complications (e.g. phlebitis and infiltration) occur • When adherence to aseptic technique cannot be ensured (i.e. when catheters are inserted during a medical emergency), replace all catheters as soon as possible and after no longer than 48 hours • Replace catheter-site dressing if the dressing becomes damp, loosened, or visibly soiled • Consider reduction of CV catheter utilization
Prevention of urinary tract infection • Emphasize hand washing for ICU staff, consultants, and parents • Limit the use of urinary catheters for patients, only if it is indicated: 1) to relieve urinary tract obstruction; 2) to permit urinary drainage in patients with neurogenic bladder dysfunction an urinary retention; 3) to aid in urologic surgery or other surgery on contiguous structures; 4) to obtain accurate measurements of urinary output in critically ill patients • Daily care of meatus with soap and water • Do not change catheters at arbitrary fixed intervals • Maintain closed sterile drainage • If breaks in aseptic technique, disconnection, or leakage occur, the collecting system should be replaced using aseptic technique after disinfecting the catheter-tubing junction • The catheter-tubing junction should be disinfected before disconnection

admitted patients) were calculated and compared between the groups (pre- vs. postintervention). In addition, the relative risk reduction (RRR), absolute risk reduction (ARR), and the number needed to treat (NNT) were calculated for ventilator-associated pneumonia (VAP), other ventilator-associated lower respiratory tract infection (LRTI), bloodstream infection (BSI), and urinary tract infection (UTI) (25).

Statistical data analysis

The data from the data collection forms were checked twice and entered into a database (Epidata, version 2.1), which is used as NI register of Lithuania. Later on, data were converted, checked again twice, and analyzed with SPSS (version 12.0) software.

Identification of the most important risk factors was performed using unadjusted analysis (2×2 cross-tabulation, chi-square test) and multivariate adjusted analysis (binary logistic regression), calculating the odds ratio (OR) and its 95% confidence interval.

Incidence rates between the groups were compared using two-proportion test and chi-square test. The samples of continuous variable were checked for normality using one-sample Kolmogorov-Smirnov test. Since the samples by age, PIM2 score, and length of stay were not normally distributed in the pre- and postintervention groups, the groups were compared using nonparametric two-sample Mann-Whitney *U* and Kolmogorov-Smirnov tests.

The data of whole sample (2005–2007) were used for calculation of an attributable mortality due to NI. We used several methods: chi-square test (for the groups by outcome by NI), binary logistic regression (whether the outcome depends on NI, major risk factors, and PIM2 score), and Kaplan-Meier survival analysis (assuming longitudinal nature of the surveillance data and that the event rate over time does not have to be constant) (13, 26). Within the survival analysis, we used log-rank and Breslow tests to check the equality of survival distributions for all NIs and separately for VAPs and BSIs.

Power of the study of 0.67 was calculated by change of the VAP incidence rate in the two groups (pre- vs. postintervention). The significance level was $P<0.05$.

Results

A total of 755 children admitted to pediatric ICUs for more than 48 hours were included in the study. Using a binary logistic regression model, statistically significant risk factors for acquiring NIs were identified: mechanical ventilation, central line, ICP device, and tracheostomy (Table 2).

The pre- and postintervention groups were homogenous by gender, age, referral place, clinical profile, PIM2 score, and length of stay, but the number of the patients with trauma was higher in the postintervention group. The two groups were homogenous by the presence of invasive devices (Table 3). We found that the NI incidence rate has decreased from 15.6 per 100 patients (CI 95%, 11.7–20.4) in the preintervention to 7.5 per 100 patients (CI 95%, 5.1–10.9) in the postintervention group ($P=0.002$), and the NI incidence density – from 19.1 per 1000 patient-days (CI 95%, 14.2–25.7) to 10.4 per 1000 patient-days (CI 95%, 7.0–15.4) ($P=0.015$). In addition, there was a significant decrease in the incidence of pneumonia (PNE) from 5.6 per 100 patients (CI 95%, 3.4–9.0) to 1.9 per 100 patients (CI 95%, 0.9–4.0) ($P=0.016$). The VAP incidence rate, ventilator-associated LRTI rate, central venous catheter- and urinary catheter-related rates did not change significantly. The mortality rate

Table 2. **Risk factors for patients to acquire nosocomial infection in the preintervention group (n=433)**

Risk factor (exposure)	% of diagnosed NIs in the exposed group	% of diagnosed NIs in the nonexposed group	Unadjusted odds ratio (95% CI)	Adjusted odds ratio (95% CI)	*P* value
Mechanical ventilation	29.4	5.6	7.00 (3.70–13.23)	4.21 (1.99–8.94)	<0.0001
Central line	30.2	7.1	5.66 (3.18–10.07)	3.44 (1.70–6.96)	0.001
Urinary catheter	25.2	6.2	5.14 (2.67–9.88)	–	>0.05
ICP device	73.1	13.0	18.13 (7.27–45.19)	6.54 (2.48–17.22)	<0.0001
Tracheostomy	43.5	15.1	4.32 (1.81–10.28)	12.08 (4.07–35.85)	<0.0001
Feeding tube	25.9	3.8	8.74 (3.90–19.57)	–	>0.05
Drain in a sterile cavity	30.6	14.8	2.53 (1.30–4.94)	–	>0.05

ICP – intracranial pressure.

Table 3. **Baseline characteristics of the groups (preintervention vs. postintervention)**

Descriptive variable	Preintervention group	Postintervention group	*P* value
Number of patients	270	322	
Gender, n (%) Male Female	 150 (55.6) 120 (44.4)	 186 (57.8) 136 (42.2)	>0.05
Age, median (interquartile range), years	4.01 (10.00)	3.74 (11.26)	>0.05
Distribution by age, n (%) <1 year 1–5 years 6–12 years >12 years	 83 (30.7) 76 (28.2) 51 (19.2) 60 (22.2)	 99 (30.7) 82 (25.5) 68 (21.1) 73 (22.7)	>0.05
Referral place, n (%) Other hospital/department Other ICU Home Nursing facility	 131 (48.5) 58 (21.5) 78 (28.9) 3 (1.1)	 172 (53.4) 60 (18.6) 87 (27.0) 3 (1.0)	>0.05
Clinical profile, n (%) Medical Surgical Burns	 167 (61.9) 69 (25.5) 28 (10.4)	 178 (55.2) 107 (33.2) 31 (9.6)	>0.05
Trauma, n (%)	62 (23.0)	98 (30.4)	0.04
Endotracheal tube/mechanical ventilation, n (%)	109 (40.4)	123 (38.2)	>0.05
Central venous catheter, n (%)	95 (35.2)	108 (33.5)	>0.05
Urinary catheter, n (%)	139 (51.5)	177 (55.5)	>0.05
PIM2 score, median (interquartile range)	0.95 (2.70)	1.20 (2.80)	>0.05
Patient-days, median (interquartile range)	5.00 (5.00)	5.00 (4.00)	>0.05

ICU – intensive care unit; PIM2 – Pediatric Index of Mortality.

has decreased significantly over the study period (6.7% vs. 2.8%, *P*=0.024) (Table 4).

The RRR, ARR, and NNT were statistically significant for VAP (66.5%, 3.7%, 27, respectively; *P*=0.016). The RRR, ARR, and NNT for ventilator-associated LRTI, BSI, and UTI were not significant (Table 5).

The two groups by outcomes (discharge or death) were homogenous by the presence of NIs (chi-square 0.24, *df*=1, *P*>0.05). In the regression model, the main risk factors having an impact on the outcome were as follows: mechanical ventilation, feeding tube, and PIM2 score, but NI was not a significant factor for the outcome (Table 6). Using Kaplan-Meier survival analysis, the mean survival time for patients with NI, VAP, or BSI was shorter than without infections (Table 7). However, the overall comparisons did not show statistically significant differences (Fig.).

Discussion

NI surveillance has proved to be very useful tool in infection control. Firstly, the NI surveillance data are very useful for the development of infection control program and later for the evaluation of its effectiveness (10, 11, 27). In our study, the infection control program based on the initial surveillance data and the data gained from the evaluation form of prevention methods was designed mainly for prevention of VAP and BSI, because these infections comprised a major part of infections and they are being claimed for increased mortality rates in the hospitals. Overall, the intervention was successful because there was a two-fold decrease in the NI incidence and incidence density, almost a three-fold decrease in the incidence of PNE; the relative risk reduction and absolute risk reduction for VAP was significant. However, the relative and absolute risk reductions for ventilator-associated

Table 4. **Incidence rates and mortality rate in the groups (preintervention vs. postintervention)**

Number and rates	Preintervention group	Postintervention group	*P* value
Number of patients, n	270	322	
Number of NIs, n	42	24	
Number of NIs by site, n (%)			
PNEs	15 (35.7)	6 (25.0)	
LRTIs	11 (26.2)	5 (20.8)	
BSIs	5 (11.9)	2 (8.4)	
UTIs	3 (7.1)	6 (25.0)	
Other	8 (19.1)	5(20.8)	
Number of patient-days, n	2199	2305	
Incidence, number of NIs per 100 patients	15.6	7.5	0.002
Incidence density, number of NIs per 1000 patient-days	19.1	10.4	0.015
Incidence of NIs by site, number of NIs per 100 patients			
PNEs	5.6	1.9	0.016
LRTIs	4.1	1.5	0.05
BSIs	1.8	0.6	>0.05
UTIs	1.1	1.9	>0.05
Other	3.0	1.5	>0.05
Mechanical ventilation days	688	682	
Number of VAPs	15	6	
Number of LRTIs	11	5	
Ventilator-associated pneumonia incidence rate, number of NIs per 1000 device-days	21.8	8.8	0.05
Ventilator-associated LRTI rate, number of NIs per 1000 device-days	16.0	7.3	>0.05
Central line days	537	739	
Number of BSIs	5	2	
Central venous catheter-associated incidence rate, number of NIs per 1000 device-days	9.3	2.7	>0.05
Urinary catheter days	693	989	
Number of UTIs	3	6	
Urinary catheter-associated incidence rate, number of NIs per 1000 device-days	4.3	6.1	>0.05
Mortality rate, n (%)	18 (6.7)	9 (2.8)	0.024

PNE – pneumonia; LRTI – other lower respiratory tract infection; BSI – bloodstream infection; UTI – urinary tract infection; VAP – ventilator-associated pneumonia.

LRTI and for catheter-related BSI have not reached the level of statistical significance, same as the device-related rates of LRTI and BSI. It is very likely to have a statistically significant risk reduction for ventilator-associated LRTI and catheter-related BSI while continuing the surveillance, because the power of current comparisons was too low (Table 5).

There are always two major concerns about the type of "before-and-after" studies: whether the groups were homogenous and whether the compliance with preventive methods was measured in the units. Firstly, neither organizational structure of the ICUs nor the staff has changed during the study period. The groups were homogenous by gender, age, referral place, clinical profile, PIM2 score, length of stay, and presence of invasive devices (Table 3). Obviously, the number of the trauma patients was higher in the postintervention group; however, trauma is not an independent

Table 5. **Relative risk reduction (RRR), absolute risk reduction (ARR), and number needed to treat (NNT) by sites of infection (preintervention group, n=270, vs. postintervention group, n=322)**

Risk factor	Number (%) of NIs in the preintervention group	Number (%) of NIs in the postintervention group	RRR, % (95% CI)	ARR, % (95% CI)	NNT, 95% CI	*P* value	1-β
Mechanical ventilation	15 (5.6)[1]	6 (1.9)[1]	66.5 (14.7; 86.8)	3.7 (0.6; 7.2)	27 (14; 154)	0.016	0.67
	11 (4.1)[2]	5 (1.6)[2]	61.9 (–8.3; 86.6)	2.5 (–0.2; 5.7)	40 (17; 551)	>0.05	0.49
Central line	5 (1.9)[3]	2 (0.6)[3]	66.5 (–71.5; 93.4)	1.3 (–0.7; 3.7)	81 (27; 143)	>0.05	0.31
Urinary catheter	3 (1.1)[4]	6 (1.9)[4]	–67.7	–0.8	–133	>0.05	0.12

[1]Number of ventilator-associated pneumonia.
[2]Number of other ventilator-associated lower respiratory tract infections.
[3]Number of bloodstream infections.
[4]Number of urinary tract infections.

Table 6. **Unadjusted and adjusted associations between the risk factors and outcomes (outcome-discharge or death, n=755)**

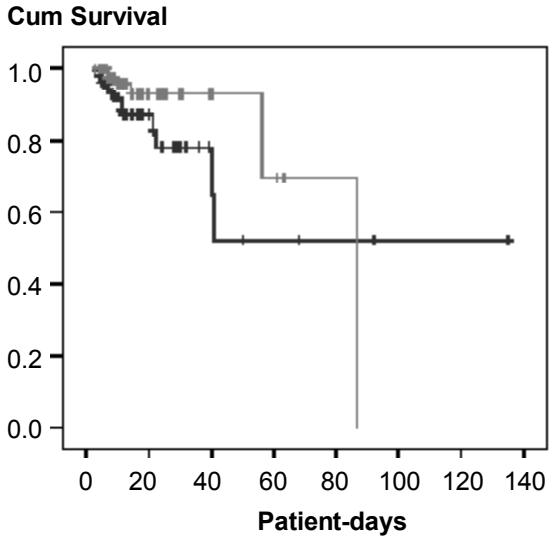
Risk factor (exposure)	% of the dead in exposed group	% of the dead in nonexposed group	Unadjusted odds ratio (95% CI)	Adjusted odds ratio (95% CI)	*P* value
Nosocomial infection	6.5	5.3	1.25 (0.51–3.06)	0.48 (0.17–1.37)	>0.05
Mechanical ventilation	11.1	1.2	10.69 (4.14–27.56)	5.47 (1.85–16.19)	0.002
Central line	8.7	3.4	2.70 (1.41–5.14)	1.40 (0.60–3.28)	>0.05
Urinary catheter	7.0	3.5	2.05 (1.03–4.09)	0.68 (0.26–1.77)	>0.05
ICP device	2.2	5.6	0.37 (0.05–2.77)	0.16 (0.02–1.22)	>0.05
Tracheostomy	12.8	5.0	2.78 (1.02–7.52)	2.24 (0.66–7.65)	>0.05
Feeding tube	9.3	0.6	17.24 (4.13–71.92)	7.16 (1.59–32.33)	0.01
PIM2	–	–	–	1.02 (1.01–1.04)	0.001

ICP – intracranial pressure; PIM2 – Pediatric Index of Mortality.

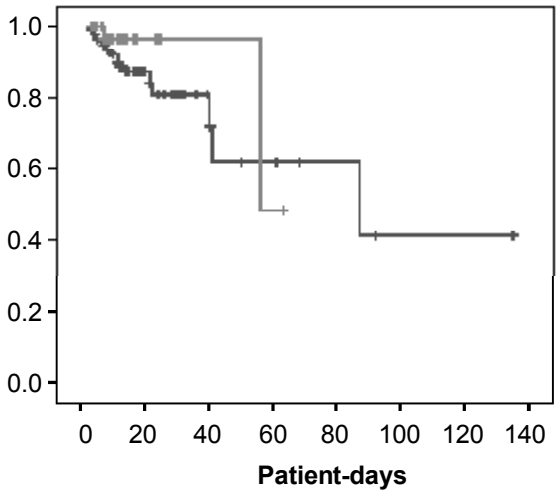
Table 7. **Survival characteristics in the groups by the presence of nosocomial infection (0 – without NI, VAP, or BSI, 1 – with NI, VAP, or BSI)**

Groups	Number of cases	Number of events	Number of censored (%)	Mean survival time, patient-days (95% CI)
NI				
0	663	35	628 (94.7)	83.67 (53.80–113.54)
1	92	6	86 (93.5)	74.33 (59.89–88.77)
VAP				
0	722	39	683 (94.6)	83.710 (58.18–109.24)
1	33	2	31 (93.9)	57.69 (51.85–63.53)
BSI				
0	742	39	703 (94.7)	88.81 (64.21–113.41)
1	13	2	11 (84.6)	76.00 (47.77–104.23)

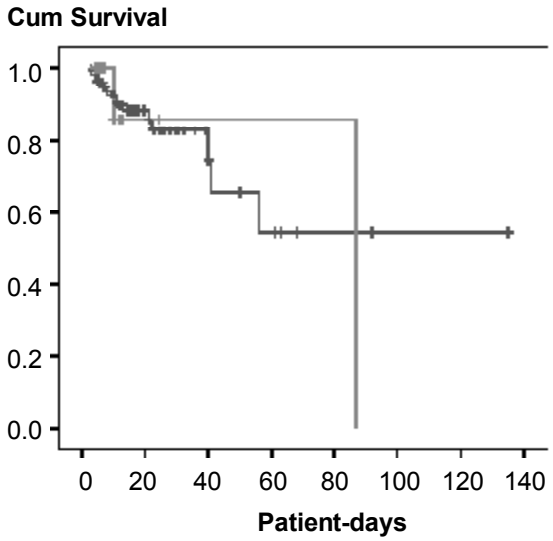
NI – nosocomial infection; VAP – ventilator-associated pneumonia; BSI – bloodstream infection.



Test	Chi-square	*df*	*P* value
Log-rank (Mantel-Cox)	3.28	1	0.07
Breslow (generalized Wilcoxon)	3.88	1	0.05



Test	Chi-square	*df*	*P* value
Log-rank (Mantel-Cox)	1.07	1	0.30
Breslow (generalized Wilcoxon)	1.16	1	0.28



Test	Chi-square	*df*	*P* value
Log-rank (Mantel-Cox)	0.03	1	0.86
Breslow (generalized Wilcoxon)	0.25	1	0.62

Fig. **Plots showing survival functions**
(all nosocomial infections, ventilator-associated pneumonia, bloodstream infection)

risk factor for NIs (28). Therefore, the impact of confounding factors on the risk and incidence rate reduction was minimized, and the major known factor, responsible for the changes mentioned above, was the intervention. Secondly, the overall compliance with the entire infection control program was checked using the evaluation form of NI prevention methods, which was filled out in each unit after the completion of intervention. Our point of view was, if the infection control program was effective, it should have a significant impact on the risk and infection rates. The accurate measure of the NI risk reduction and incidence rates, but not the accurate measure of the compliance with each preventive method itself, was the point of the study.

Our belief and the knowledge of mortality attributable to NIs comes from historical evidence and from adult ICU, neonatal ICU studies, or from the entire hospital-wide NI surveillance data analyses, published in the last decades (29–38). However, there are not so many extensive studies from pediatric ICUs or children hospitals supporting this evidence (10, 39–42). Even more and more often a critical approach regarding the children's mortality due to NI is asserted (10, 41–46). Moreover, in a large part of the studies, simply the mortality rate of the group with NI vs. without NI is compared using unadjusted analysis methods, which are not accurate enough to conclude that NI increases the mortality rate by some percentage (10, 41, 42, 44, 46). We used a multivariate regression analysis and time-adjusted survival analysis in order to find a significant association between the NI and the outcome. Although there was a significant decrease in the mortality rate in the postintervention group, and some evidence from the survival plot for NI and from Breslow test could be distinguished regarding the impact of NI on short-term survival; however, the definite association between NI and outcome was not found. In our opinion, there were several reasons for the "negative" result. First, VAP and LRTI were the first most common NIs among pediatric ICU patients; however, the attributable mortality for patients with VAP has not been proved yet in matched case-control studies (47). Second, BSI was the second most common NI, but its incidence rate was modest and onward decreasing, whereas the BSI has been described having a major impact on attributable mortality due to NI (29, 31, 33, 34, 39, 41, 42). Moreover, the third consequent explanation is that children usually do not suffer from the chronic underlying pathology comparing with the adults; therefore, children are at lower baseline risk to die. Thereby, the critical approach, regarding attributable mortality due to NIs in pediatric patients, was sustained in our study.

Conclusions

The most important risk factors for acquiring nosocomial infections were mechanical ventilation, central line, intracranial pressure device, and tracheostomy. After the implementation of multimodal intervention, which included education of the staff and implementation of evidence-based infection control measures, there was a statistically significant decrease in the incidence and incidence density of nosocomial infections, incidence of pneumonia, and the risk reduction for ventilator-associated pneumonia in pediatric intensive care units in Lithuania. No significant impact of nosocomial infections on mortality was determined.

Sergamumo ir rizikos susirgti hospitalinėmis infekcijomis mažinimas bei hospitalinių infekcijų įtaka ligonių mirštamumui vaikų intensyviosios terapijos skyriuose Lietuvoje

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Raktažodžiai: hospitalinė infekcija, vaikų intensyvioji terapija, sergamumas, rizika, mirštamumas.

Santrauka. *Tyrimo tikslas.* Nustatyti pagrindinius hospitalinių infekcijų rizikos veiksnius, įvertinti hospitalinių infekcijų sergamumo ir rizikos pokyčius po intervencijos bei hospitalinių infekcijų įtaką ligonių mirštamumui.

Metodai. Perspektyvusis stebėjimo tyrimas vykdytas trijuose Lietuvos vaikų intensyviosios terapijos skyriuose 2005 m. sausio – 2007 m. gruodžio mėn. Į tyrimą įtraukti visi 1 mėn. –18 metų vaikai, kurie gydyti vaikų intensyviosios terapijos skyriuose ilgiau nei 48 val. Ligoniai suskirstyti į dvi grupes ir duomenys lyginti dviejų grupių: prieš intervenciją (2006) ir po intervencijos (2007). Intervenciją sudarė darbuotojų mokymas ir įrodymais pagrįstų hospitalinių infekcijų profilaktikos priemonių diegimas.

Rezultatai. Tyrime dalyvavo 755 pacientai. Išskirti šie pagrindiniai hospitalinių infekcijų rizikos veiksniai: dirbtinė plaučių ventiliacija, centrinės venos kateteris, intrakranijinio slėgio daviklis ir tracheostominis vamzdelis. Grupėje po intervencijos sergamumas hospitalinėmis infekcijomis sumažėjo nuo 15,6 iki 7,5 atvejų 100 ligonių (p=0,002), nuo 19,1 atvejo iki 10,4 atvejo 1000 lovadienių (p=0,015), sumažėjo sergamumas pneumonija nuo 5,6 iki 1,9 atvejo 100 ligonių (p=0,016). Nustatytas statistiškai reikšmingas ventiliacinės pneumonijos santykinės ir absoliučios rizikos sumažėjimas bei skaičius pacientų, kuriems profilaktikos priemonės buvo veiksmingos (66,5 proc., 3,7 proc., 27, p=0,016). Išgyvenamumo analizės metodu nenustatyta statistiškai reikšmingai ilgesnė išgyvenimo trukmė ligonių be hospitalinių infekcijų, lyginant su ligoniais, įgijusiais infekcijas (83,67 ir 74,33 lovadienio, p>0,05).

Išvados. Pagrindiniai hospitalinių infekcijų rizikos veiksniai buvo dirbtinė plaučių ventiliacija, centrinės venos kateteris, intrakranijinio slėgio daviklis ir tracheostominis vamzdelis. Po intervencijos statistiškai reikšmingai sumažėjo sergamumas hospitalinėmis infekcijomis, taip pat rizika susirgti ventiliacine pneumonija. Nenustatyta statistiškai reikšminga hospitalinių infekcijų įtaka ligonių mirštamumui.

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Received 14 April 2008, accepted 6 March 2009
Straipsnis gautas 2008 04 14, priimtas 2009 03 06