

Nosocomial Infections Incidence Rates, Bulgaria, 1999-2011

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Abstract

The study presents an analysis in two parts of the officially registered NI in the country by the computerized information system (CIS-NI) in the course of a 13-year period (1999-2011). The system employs two types of indices-incidence rate (morbidity, recalculated in the study per 1000 patients discharged) and percentage distribution (frequency distribution, relative frequency distribution) by infection sites and microbial agents. This part discusses the overall NI incidence rates by hospital and wards categories, accentuating upon pediatric and intensive care wards-anesthesiology and resuscitation, intensive therapy.

The average incidence rate is 10% at the following distribution by infection sites: VAP-5%, surgical site infections (SSI) and pulmonary infections (the latter including bronchitis, bronchiolitis, pneumonia, non-associated with procedure of endotracheal intubation) of 16-18% each; urinary tract infections (UTI) 13-15%; sepsis 4-5%, enteric, skin infections, of the sense organs, intraabdominal and cardiovascular system infections-approximately 2% of each group, endometritis and other gynecologic infections-1%, mastitis in young mothers-0.1%. Microbiologically diagnosed are 50-60% of the infections as a total and in 40-50% unconfirmed and unexamined microbiologically.

E. coli and *S. aureus* are identified in about one third of the total number of infections, the rest isolates pertain to opportunistic bacterial species, known for their multiresistance: *Klebsiella* spp, *Pseudomonas* spp, *Acinetobacter* spp etc.

The incidence rate of infections ranges within low limits, e.g. LRTIs (pulmonary infections)-pediatric wards-up to 3%; VAP/ pulmonary infections-resuscitation (A&R) 15-19%, intensive therapy (IT) 5-8%; UTIs-resuscitation, urology-13%; SSIs-burn units-38%, septic surgery-23%, vascular surgery-11%; sepsis-burn units-22%, resuscitation-8%, cardiovascular surgery-6%, ICUs-5%.

The official registration system provides reliable information on a national level for the purpose of NI surveillance and control. The system interprets the original data of the wards in basic indices as incidence and microbial isolates' distribution. This official database reflects the efforts in the sphere of NI prevention and control. Possible additional links to the system would contribute to direct comparisons of indices regarding the care for patients undergoing risk procedures.

Keywords: Nosocomial infections; Computerized information system-nosocomial infections; Ventilator-associated pneumonia; Acute upper respiratory tract infections; Lower respiratory tract infections [(LRTIs), pulmonary infections]; Surgical site infections; Urinary tract infections; Sepsis; Anesthesiology, resuscitation and intensive care units; Anesthesiology and resuscitation; Intensive care units; Intensive therapy

Introduction

Nosocomial infections (NI) surveillance and control is estimated as an important task of the healthcare organization in our country. A national NI surveillance system was introduced in 1981, based on computer processing of the original documents from practically all health-care facilities. A review of the indices adopted is made by means of official reports and specialized studies. However, distinct effects on the NI incidence are difficult to demonstrate, in spite of achievements made in the infection control in the country as effective education and training on the problems, an organization for control measures, reconstruction and modern technology equipment ensured for sterile services departments (SSDs) and hospital wards. The problems of nosocomial infections are related to a great extent to the adequacy of funds invested in infection control directly for the SSDs to be constructed and equipped according to the most exigible and strict regulatory requirements, the disinfection and sterilization activities and the healthcare facilities construction/reconstruction

and equipment to be subject to strict regulatory measures as well, the antibiotics policy to be conformable with the reference guides and the monitoring of the local hospital strains antibacterial resistance.

Objective

The present study analyzes the nosocomial infections distribution in the country by infection sites and microbial isolates for the period 1999-2011 on the basis of the official registration data of the computerized information system-nosocomial infections (CIS-NI). Two additional files, related to the observation of patients with risk procedures, and adapted with certain modifications from external sources, are proposed to be processed within the feed-back of the official system with the

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wards. The files are considered to be of use for the documentation of the personnel responsibilities in the care for patients on mechanical ventilation, and/or central/peripheral line.

Materials and Methods

In this first part of the study the analysis of nosocomial infections distribution in the country is based on the indices submitted by CIS-NI, i.e. distribution by major NI classification groups and wards. A comparatively long period-from 1999 to 2011 including, has been followed up with certain highlights of 2010-2011 data.

CIS-NI operates with incidence rate indices, an analogue of the term “morbidity rate”, calculated in the case of NI as a proportion of the number of infections (in a numerator) to the patients discharged (in a denominator), multiplied by 100. However, in view of the comparability with some internationally adopted criteria for estimation of NI distribution, CIS-NI values have been recalculated in our study per 1000 patients discharged.

The study demonstrates:

- NI overall incidence rates by infection sites;
- NI overall percentage distribution by infection sites and microbial isolates.

Rates and percentages are presented in details regarding two subcategories of wards:

- Pediatric wards;
- Intensive care wards-anesthesiology and resuscitation, intensive therapy (intensive care units) and surgical wards.

The recent updates (2011) in CIS-NI have been taken into account, i.e.

- Updated nomenclature of the healthcare facilities in conformity with the agreements with the National Health Insurance Fund, surgical specialities better differentiated;
- Two corrections in the infections nomenclature of the original official document, i.e. first, requirement for the registration of the ventilator-associated pneumonia (VAP), and second, requirement of no longer reporting of the acute upper respiratory tract infections (AURTIs) as a separate nosological (classification) group, the infections of this type included into the combined group of the “other infections”.

Results

Overall NI incidence rates by hospital category, overall percentage distribution by infection sites and etiologic agents

Overall NI incidence rates: Recently, and for the last 3 years of the period studied concretely, NI reporting and registration have been maintained about 10%: 2009-10.2%; 2010-10.4%; 2011-9.4% (Table 1). The update of 2011 revealed similar registration level in the multi-profile hospitals for active treatment (MPHAT) corresponding to the former university and municipal hospitals (about 9%), and the specialized hospitals for active treatment (SHAT) corresponding to the former specialized hospitals-obstetrics and gynecology etc. (about 8%). A rate of about 30% is documented for psychiatric hospitals, a very low level of registration in the private healthcare facilities, the specialized centers (oncologic/psychiatric/dematology and venerology) and hospitals to other administrations about 3-4%. In the centers for medical and social

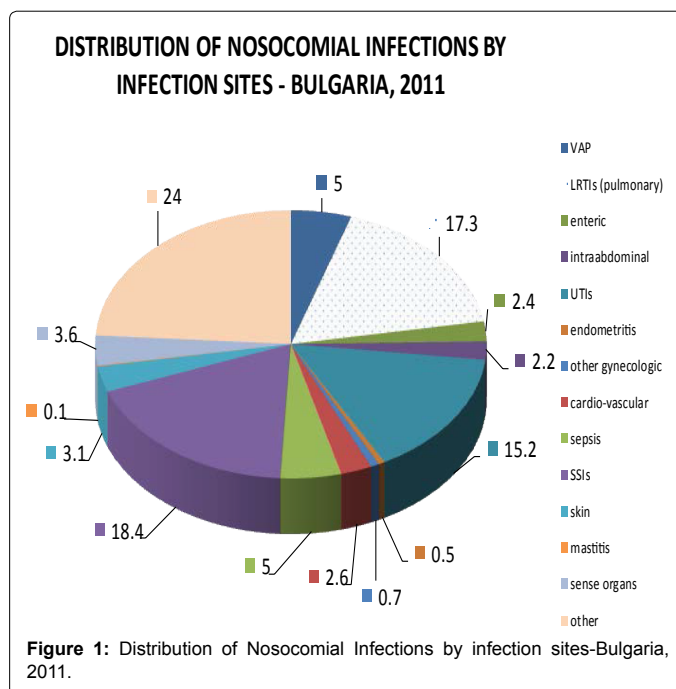
care for children [(CMSCC)-orphanages-children up to 3 years of age], the markedly higher incidence values through the years, of more than 400% in 2011, have been determined mainly by the AURTIs reported (Table 1).

Overall NI percentage distribution by infection sites (by infections classification groups)

The introduction of VAP as a separate nosological category (classification group) was imposed by the necessity of compliance with the admitted and demonstrated by all nosocomial infections studies substantial risk for the critically ill patients on mechanical ventilation, e.g.,

- Confirmed highest incidence rate of this complication in critically ill patients in resuscitation wards and intensive care units [1,2];
- Two fold higher mortality rate in patients with VAP in comparison with the intubated patients without such clinical data-(according to a review of the English and American references for the period 1990-2005) [3] and
- Additional costs due to the prolonged hospital stay [1,3].

As of 2011 the notified VAP cases in the country amount to 5% of all registered nosocomial infections (Figure 1): The proportion of the remaining infections groups corresponds to the data for the previous years, i.e. surgical site infections (SSIs) 16-18% for 2010-2011; lower respiratory tract infections [(LRTIs) pulmonary infections (bronchitis, bronchiolitis, pneumonia, non-associated with a procedure of mechanical ventilation)] 18-17%; urinary tract infections (UTIs) 13-15%; sepsis-about 4-5%, enteric, skin infections, of the sense organs, intraabdominal and of the cardiovascular system-about 2% respectively for each group, endometritis and other gynecological infections-about 1% as a total, mastitis in young mothers-0.1%. In 2011 the percentage of the “other” infections, not classified in the indicated groups, has increased from 5% to 24% on account of the AURTIs, already included into this group (Figure 1).



Overall NI percentage distribution by etiologic agents

In the course of the period studied (1999-2011) CIS-NI data indicate that only in 50-60% NI are etiologically clarified, the rest 40-50% as a total are microbiologically unconfirmed and untested. For the last two years (2010-2011) the percentage of the microbiologically

Hospital category	2011
MPHAT	8.9
SHAT	7.4
Other specialized	0.7
Private healthcare facilities	2.6
Psychiatric	28.2
(Onco-/psych-/dermatology and venerology)	3.8
Hospitals to other administrations	3.8
Other	1.1
CMSCC	476.1
All healthcare facilities	9.4

*The complete set of tables with the numerical data by years for the 1999-2011 period is available with the editors.

Table 1: NI overall incidence rates (per 1000 patients discharged) by hospital category for the period 1999-2011*.

Hospital category	1999	2000	2001	2002	2003	2004	2005	2006
University	35.93	35.45	40.44	35.66	37.81	37.15	38.87	37.97
First-rate municipal	39.28	39.16	36.92	41.60	42.45	43.99	43.38	42.63
Urban	43.18	41.26	40.70	42.10	41.80	40.54	39.94	36.64
Municipal	41.74	41.01	40.70	39.93	41.18	40.73	43.03	42.51
Specialized obstetrics and gynecology	18.53	13.96	14.80	14.83	12.59	16.02	17.07	20.48
Specialized pediatric	80.61	14.84	45.27	70.05	83.14	56.60	88.43	74.86
Other specialized	32.54	30.69	28.36	29.05	30.51	27.25	32.56	29.40
CMSCC	57.12	64.80	55.18	57.91	50.10	49.23	36.40	35.11
Other	3.09	2.68	10.66	9.78	14.95	13.70	15.30	15.56

Hospital category	2007	2008	2009	2010	Hospital category	2011
University	36.43	34.83	35.50	40.83	MPHAT	40.45
First-rate municipal	44.13	42.15	41.20	41.87	SHAT	42.59
Urban	37.75	33.89	28.80	33.17	other specialized	7.33
Municipal	42.84	40.75	40.89	43.30	Private healthcare facilities	32.12
Specialized obstetrics and gynecology	26.06	23.12	29.21	29.07	Psychiatric	5.72
Specialized pediatric	75.41	70.75	71.51	62.85	Centers (onco-/psych-/dermatology and venerology)	12.02
Other specialized	28.98	28.80	27.45	25.09	Hospitals to other administrations	20.73
CMSCC	36.12	29.10	35.87	45.83	Other	0.09
Other	19.82	16.83	15.54	0.10	CMSCC	38.08

Table 2: Percentage of treated with antibiotics patients by hospital category for the period 1999-2011.

VAP	bacteriologically unconfirmed	Number →26	% →2.8
	unexamined	6	0.6
Pulmonary infections	bacteriologically unconfirmed	580	18.3
	unexamined	906	28.6
SSIs	bacteriologically unconfirmed	217	6.4
	unexamined	46	1.4
Cardiovascular system infections	bacteriologically unconfirmed	116	24.0
	unexamined	289	59.7
UTIs	bacteriologically unconfirmed	186	6.7
	unexamined	59	2.1
Sepsis	bacteriologically unconfirmed	38	4.2
	unexamined	4	0.4

Table 3: Percentage of unconfirmed and unexamined microbiologically infections (some principal ni groups) in 2011.

unproven infections has increased from 17 to 27%, the unexamined microbiologically having been 22-23%. The infections, remaining without an etiological diagnosis are predominantly AURTIs. However, according to 2011 data, a part of important and of serious consequences infections like VAP, LRTIs (pulmonary) infections, SSIs, cardiovascular infections, UTIs, sepsis, have not been confirmed bacteriologically or are unexamined. The cardiovascular infections in approximately 60% of the cases have not been tested, and in another 24% no causative agent has been identified, presumably it refers to superficial phlebitis in blood manipulations, usually treated conservatively, no necessity of sampling for testing (Tables 2 and 3).

The microbiologically identified infections have maintained their characteristics in the course of years. *E. coli* and *S. aureus* have been isolated as principal microbial agents, determining together one third of the infections. For instance for the last 5 years (2007-2011). *E. coli* has been isolated annually in 18-17%, *S. aureus* in 13-15% of the infections. These microorganisms have been isolated in the highest percentage according to USA Surveillance Network data as well-17-19% of the bacterial isolates from inpatients between 1998-2005 (Figure 2) [4].

Among the most frequent microbial agents, isolated in infections treated as nosocomial ones are a number of Gram-negative bacteria,

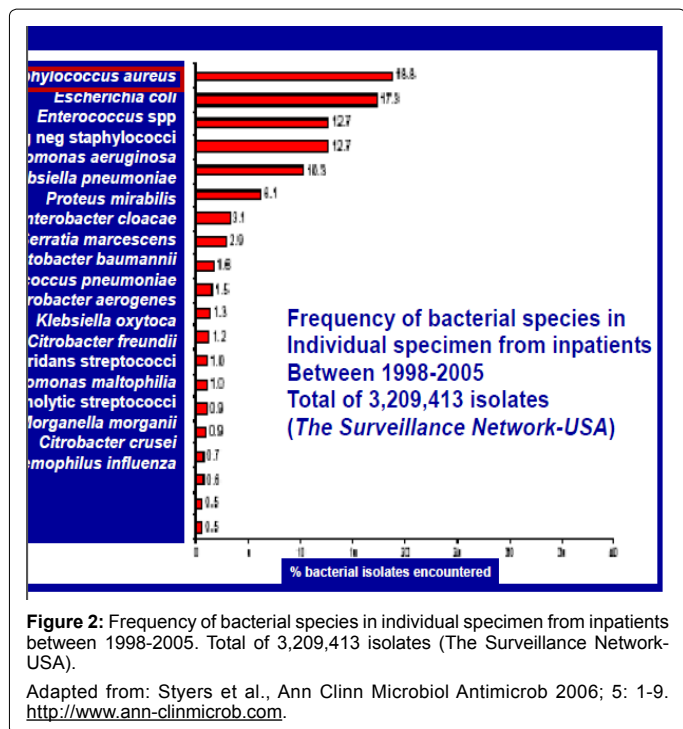


Figure 2: Frequency of bacterial species in individual specimen from inpatients between 1998-2005. Total of 3,209,413 isolates (The Surveillance Network-USA).

Adapted from: Styers et al., Ann Clin Microbiol Antimicrob 2006; 5: 1-9. <http://www.ann-clinmicrob.com>.

Wards	1999	2000	2001	2002	2003	2004	2005	2006
Neonatal	27.8	20.2	17.2	20.1	22.3	19.3	21.3	20.2
Nicu	227.4	123.2	213	221.4	308.2	193.6	206.2	278.3
Hypothrophic	513.8	344.8	144.2	435.8	381.1	78.1	129.3	487.3
Nurselings	29	66.8	38.8	28.4	25.3	20.7	30.1	60.2
Generalprofile	43.2	57.4	47.9	43	41.8	36.1	23	32
Internal	17.2	17.9	18.6	24.4	20.2	14.2	9.4	12.2

Wards	2007	2008	2009	2010	Wards	2011
neonatal	21.4	20.4	16.6	17.5	Neonatal	16.3
NICU	393.8	368	419.9	186.4	NICU, Hypothrophic	0
hypothrophic	513.2	367	259.7	300.7		
Nurselings	43.9	31.4	30.8	12.1	Nurselings	3.5
Generalprofile	32.8	22.2	24.4	25	Pediatric	4.2
Internal	12.5	10.2	14.1	9.8		

Table 4: NI overall incidence rate (per 1000 patients discharged) in the pediatric wards, 1999-2011.

pertaining to the so-called conditionally pathogenic¹ or opportunistic bacteria², known for the multiresistance of their hospital strains [5-11]. The participation of Gram-positive microorganisms as coagulase-negative staphylococci (CoNS) to this group has recently been emphasized, particularly in cases of central venous catheter related infections [4,9].

In the course of the period studied from 1999 to 2011 the isolates of opportunistic bacteria determine a stable and even a rising percentage as follows:

¹Conditionally pathogenic bacteria are only pathogenic under certain conditions, such as a wound that allows for entry into the blood, or a decrease in immune function [5].

²Opportunistic microorganisms are usually found in the environment or as part of the normal flora. In normal individuals, they are harmless, but they may cause severe disease in immunocompromised patients or if they penetrate a territory from which they are usually excluded (as a result, for example, of trauma or surgery) definition adapted by G. Virella [6]. Both terms are usually compatible.

- Isolated in increasing percentage:
 - *Klebsiella* spp, predominantly *K. pneumoniae*-8 to 12%, for the last 2 years 14-12%;
 - *Acinetobacter* spp, with a leading causative agent of the species-*A. baumannii*-7 to 9%;
 - *Enterococcus* spp with the greatest number of isolates of *Enterococcus faecalis* from 4 to 8%;
- Of comparatively stable isolation level:
 - The isolation level of *P. aeruginosa* has been maintained at 10%; *Proteus* spp, mainly *P. mirabilis*; *Enterobacter* spp, of which the highest number of isolates of *Enterobacter cloacae*-each of the species of about 4-5%; *Serratia* spp, exclusively strains of *Serratia marcescens* 1-2%;
 - Coagulase-negative *Staphylococci* (in a considerable percentage *S. epidermidis*) 6-8%.

NI by wards

Overall incidence rates, rates by principal infection sites, percentage distribution by infection sites

Pediatric wards: The neonatal intensive care units (NICUs) are classified under the categories prematures (preterms) and hypothrophic infants up to 2010, and in 2011 under the category of preterms, comprising the previously distinguished category of the hypothrophic infants.

The follow up in the course of the period studied has demonstrated the importance of the following NI groups for the pediatric wards:

Up to 2010 the AURTIs in fact determined the greatest part of the reported infections by these wards. With the falling off of this category as a separate nosologic group in 2011 the overall incidence rate declines to 16.3% in the neonatal wards (term infants), NICUs-0.0%, infants up to 1 year of age-3.5%, and in the general profile and internal pediatric wards-4.2% (Table 4).

A considerable number of AURTIs have been notified yearly incorrectly under the category of pulmonary infections, the latter including, on account of IDC³ only infections of the lower respiratory tract as bronchitis, bronchiolitis and pneumonia. Thus the percentage and the rates of the lower respiratory tract infections (LRTIs) have been artificially exaggerated. For example, up to 2010 LRTIs comprised the highest proportion of the notified infections in the neonatal wards (16-17%), infants 16-17%; NICU 10-23%*. The rates for NICU, for instance, have been varying within broad limits, mostly within higher values, i.e. NICU-16-84%, hypothrophic infants 9-85% respectively (Table 5). The exclusion of AURTIs as a separate classification group led to a considerable decrease in the rates in 2011. The incidence in the infants' wards, ranging between 2.5 and 11% till 2010 decreases to 0.6% in 2011, in the pediatric therapeutic wards (general profile) the rate varying within the range of 4-11% till 2010 is reduced to 1.1% in 2011 (Table 5).

The follow up in the course of the period studied have demonstrated the importance of the following NI groups for the pediatric wards (Tables 5-7).

Enteric infections: Amount to about 7-12% of the reported infections in the neonatal wards, infants 2-8%, pediatric wards-3-19%*. In 2011 there has been a noticeable increase in the enteric infections

³International Disease Classification

Wards	1999	2000	2001	2002	2003	2004	2005	2006
Obstetrics and gynecology (O&G) – general profile	0.1	0.0	0.1	0.2	0.3	0.1	0.0	0.0
Neonatal	1.6	0.9	1.4	3.2	2.5	1.5	3.1	3.7
Nicu	19.7	15.6	24.0	27.5	53.8	19.9	33.6	23.7
Hypothrophic	84.8	64.0	25.8	91.9	34.5	9.4	26.0	45.7
Nurselings	4.4	11.1	1.8	3.2	3.2	2.8	3.7	11.7
General profile	8.4	11.4	8.5	8.5	7.0	7.9	3.9	7.8
Internal	1.0	3.6	2.7	3.6	2.8	2.3	0.5	0.8

Wards	2007	2008	2009	2010	Wards	2011
O&G – general profile	0.1	0.0	0.0	0.0	O&G – general profile	0.0
Neonatal	0.04	3.6	2.6	2.8	Neonatal	2.6
NICU	81.4	83.7	57.0	29.9	NICU, hypothrophic	0.0
Hypothrophic	76.3	32.0	20.5	6.7		
Nurselings	6.6	5.0	6.3	2.5	Infants	0.6
General profile	4.9	3.8	4.1	4.7	Pediatric	1.1
Internal	3.1	1.3	1.3	1.0		

Table 5: LRTIs (pulmonary infections) incidence rate (per 1000 patients discharged) in the pediatric wards, 1999-2011.

Wards	1999	2000	2001	2002	2003	2004	2005	2006
Obstetrics and gynecology (O&G)– general profile	0.2	0.9	0.0	0.0	0.0	0.3	0.1	0.3
Neonatal	0.1	0.2	0.4	0.2	0.4	0.6	0.7	0.4
NICU	6.3	3.0	6.5	7.8	7.7	16.7	12.0	10.1
Hypothrophic	31.1	16.6	6.9	6.3	6.4	2.0	6.1	2.5
Nurselings	0.1	0.4	0.1	0.4	0.5	1.0	2.0	1.0
General profile	1.3	0.9	1.6	1.0	1.0	0.9	0.6	0.5
Internal	0.1	0.3	2.0	0.5	1.1	0.4	1.4	0.1

Wards	2007	2008	2009	2010	Wards	2011
O&G – general profile	0.2	0.2	0.4	0.1	O&G – general profile	0.3
Neonatal	0.5	0.4	0.1	0.3	Neonatal	0.2
NICU	10.8	11.0	11.7	9.0	NICU, hypothrophic	0.0
Hypothrophic	0.0	7.4	4.5	10.1		
Nurselings	0.3	0.6	0.6	0.0	Infants	0.0
General profile	0.5	0.5	0.6	0.6	Pediatric	0.3
Internal	0.1	0.1	0.0	0.1		

Table 6: UTIs incidence rate (per 1000 patients discharged) in the pediatric wards, 1999-2011.

Wards	1999	2000	2001	2002	2003	2004	2005	2006
Obstetrics and gynecology (O&G)– general profile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Neonatal	1.4	1.5	0.7	0.9	0.8	0.4	1.3	1.0
Nicu	0.0	0.7	1.6	0.0	0.0	0.0	0.0	0.0
Hypothrophic	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0
Nurselings	0.1	0.2	0.0	0.0	0.1	0.2	0.0	0.1
General profile	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0
Internal	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.2

Wards	2007	2008	2009	2010	WARDS	2011
O&G – general profile	0.0	0.0	0.0	0.0	O&G – general profile	0.0
Neonatal	0.9	1.0	1.0	0.8	Neonatal	1.2
NICU	0.0	1.7	0.8	0.5	NICU, hypothrophic	0.0
Hypothrophic	0.0	0.0	0.0	0.0		
Nurselings	0.3	0.0	0.0	0.0	Infants	0.0
General profile	0.1	0.0	0.1	0.1	Pediatric	0.3
Internal	0.0	0.0	0.2	0.1		

Table 7: Sepsis incidence rate (per 1000 patients discharged) in the pediatric wards, 1999-2011.

in the infants' wards (up to 50% of the registered infections), due to enteroviruses epidemic distribution.

Skin infections: The percentage is higher (5-18%) for the neonatal wards in relation to eventual possibility for dissemination, compared to NICU 0-4%, infants/pediatric (general profile) wards 0-2/3%*.

Infections of the sense organs, usually referring to conjunctivitis: Outbreaks of bacterial conjunctivitis, predominantly staphylococcal in the past, for the time being are not registered. However, these infections still comprise the highest percentage of the reported infections in the neonatal wards 30-40%. In NICU and the infants wards the conjunctivitis are more rarely encountered-NICU 3-14% of the registered infections, infants 1-3%, with exceptions in years of epidemic outbreaks, e.g. in 2011 these infections in the infants wards reached 12.5% of the reported infections, due to distribution of viral conjunctivitis*.

UTIs: The UTIs comprise 1-3% of the NI in the neonatal wards, 3-9%-NICU*. The rates are within low limits for the neonatal/pediatric wards 0.2-0.3%, and higher and variable for NICU (NICU-3 to 17%, NICU-hypothrophic children 0.0-31.1%), in the neonatal intensive care wards urinary catheterization procedures should be considered (Table 6).

Sepsis: The single cases reported in separate years by the pediatric wards determine very low incidence rate level of the order of 0.8 to 1.2%-neonatal wards, 0.0-1.7%-NICU, 0.0-0.5%-hypothrophic, 0.0-0.3%-infants, 0.0-0.1% general profile, 0.0-0.2% internal pediatric wards (Table 7).

Cardiovascular infections have not been registered by the neonatal/infants wards, several single cases have been reported by the wards for elder children.

*The complete set of tables with the numerical data by years for the 1999-2011 period is available with the editors.

Anesthesiology and resuscitation, intensive therapy [(intensive care units (ICUs)] and surgical wards

The nomenclature of the wards till 2010 included the following separate categories: Anesthesiology and resuscitation intensive care unit (ARICU), ARICU-neurosurgery, pediatric, medical intensive care unit. Since 2011 these wards are classified into the general categories: "anesthesiology and resuscitation (A&R)" and "intensive therapy (IT)", the latter comprising the intensive care units (ICUs).

Wards	1999	2000	2001	2002	2003	2004	2005	2006
ARICU	110.3	195.3	100.8	86.8	67.1	72.1	72.7	94.8
ARICU-neurosurgery	87.5	70.7	80.8	124.1	134.0	110.2	107.9	60.2
Pediatric ICUs	46.7	56.7	18.1	43.4	12.8	21.0	43.3	36.0
Surgical-general profile	13.7	15.0	14.2	11.1	11.5	10.1	11.9	14.8
Orthopedics and traumatology	11.4	10.2	8.3	9.1	8.3	6.1	7.4	9.0
Neurosurgery	17.1	18.8	17.5	14.2	12.8	16.0	11.8	14.8
Cardiovascular surgery	23.8	20.2	18.0	21.9	22.3	12.5	15.6	12.8
Urology	41.0	40.9	39.3	33.9	30.7	30.1	34.8	32.3
Pediatric surgical-	11.0	11.4	10.2	9.0	12.4	7.1	12.7	17.0
Burns	58.7	59.3	95.0	98.5	91.6	80.2	58.8	62.5
Other								
Gynecology	2.9	2.4	3.8	3.1	3.3	2.7	4.8	5.4
Oncology	4.6	2.5	3.2	4.8	3.0	3.9	3.8	3.6
Internal – general profile	6.5	4.5	4.6	3.8	5.0	2.5	2.7	2.9
Neurology	13.6	12.9	12.8	10.0	7.2	5.5	5.0	4.3
Psychiatry	45.7	41.2	26.3	27.2	25.1	17.5	23.1	16.9

Wards	2007	2008	2009	2010	Wards	2011
ARICU	97.8	82.3	69.4	60.8	Anesthesiology and resuscitation (A&R)	73.0
ARICU-neurosurgery	40.3	35.8	83.9	123.5		
Pediatric ICUs	24.6	30.6	55.5	41.0	Intensive therapy (IT)	25.6
Surgical-general profile	13.0	11.2	12.1	13.1	Surgery	13.5
Orthopedics and traumatology	8.6	5.9	7.3	8.1	Orthopedics and traumatology	7.4
Neurosurgery	12.7	13.9	15.8	11.0	Neurosurgery	9.7
Cardiovascular surgery	11.4	11.7	13.0	14.6	Cardiac surgery	31.3
					Vascular surgery	13.0
Urology	25.7	27.7	21.4	21.4	Urology	16.9
Pediatric surgery	13.7	13.2	14.0	13.4	Pediatric surgery	14.0
					Septic surgery	24.3
Burns	53.5	39.2	48.9	89.9	Burns	122.8
Other					Other	
Gynecology	6.4	6.1	6.0	6.7	Gynecology	8.5
Oncology	2.2	2.1	2.2	3.7	Oncology	5.1
Internal – general profile	2.8	2.9	2.5	2.2	Internal – general profile	2.1
Neurology	4.2	3.4	4.1	4.4	Neurology	2.9
Psychiatry	19.4	15.1	10.5	9.8	Psychiatry	6.7

Table 8: Overall NI incidence rate (per 1000 patients discharged) in resuscitation, ICUs and surgical wards, 1999-2011.

Compared to the previous period the 2011 overall incidence rate for the high-risk A&R and IT units does not differ substantially: anesthesiology and reanimation-73%, intensive therapy (IT)-26%, burns-123% (Table 8).

The subdivision of “cardiovascular surgery” to cardiac surgery and vascular surgery provides a possibility for a more exact idea about the overall infections level-for 2011 33% and 13% respectively. The rate for septic surgery units (in view of dirty and infected wounds treatment) is 24%, and in the rest special surgery wards-between 10% and 17% (Table 8).

VAP/LRTIs (pulmonary infections)

An important element is the introduction of VAP in the reporting system at the basis of:

- VAP was confirmed as the most serious complications in patients on mechanical ventilation (according to the references in 8-28%, and in particular critically ill patients on cardiopulmonary resuscitation) [12].

- This type of pulmonary infection is related to high mortality rate from 24 to 50%, which may reach 76% in some specific wards, or when the pulmonary infection is caused by pathogens the identification of which in tracheobrochial aspirate samples is related to a high risk of infection development, the so called “highrisk pathogens” [13-15].

The reason for VAP introduction as a separate infection category was an avoidance of formal reporting. For the period 1999 to 2010 about 30-50% of the registered infections in ARICUs and ICUs were pulmonary ones, AURTIs incorrectly registered under this category: ARICUs 36-44%, ARICU to the neurosurgery 17-46%. In 2011 VAP already amounts to 20% of the infections in each of these two types of wards-A&R and IT respectively, the pulmonary infections non-related to mechanical ventilation 26-31% respectively*. The compared rates VAP/pulmonary infections amount to: A&R-15/19%, IT-5/8%. Special surgery wards having indicated VAP /pulmonary infections are cardiac surgery-4/18% of all NI (1.2/5.6%), thoracic surgery-5/30% (0.7/3.9%), pediatric surgery-4/7% (0.6/0.9%), the rates for the rest surgical wards being within 0,0-0.9% on the basis of single notified cases (Table 9).

Wards	1999	2000	2001	2002	2003	2004	2005	2006
ARICU	39.3	33.0	34.9	38.1	29.9	29.3	27.1	35.3
ARICU-neurosurgery	21.1	34.6	17.9	44.2	45.2	33.2	49.4	23.2
Medical ICUs	0.4	3.7	4.3	2.3	2.6	1.0	2.4	2.3
Pediatric ICUs	6.7	11.1	2.5	1.1	1.8	1.7	2.5	4.0
Surgical-general profile	0.8	0.5	0.5	0.5	0.4	0.6	0.4	0.6
Orthopedics and traumatology	0.4	0.7	0.6	0.6	0.2	0.1	0.4	0.3
Neurosurgery	0.9	1.3	0.6	0.2	3.2	7.0	0.9	1.7
Cardiovascular surgery	0.4	2.7	3.1	2.3	5.2	2.1	3.7	3.1
Urology	0.4	0.2	0.1	0.1	0.3	0.4	0.3	0.4
Pediatric surgery	1.2	1.3	1.0	1.1	0.9	0.3	0.8	0.4
Burns	7.7	7.7	18.0	8.8	5.1	4.2	3.5	2.6
Other								
Gynecology	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oncology	1.0	0.7	0.6	1.0	1.0	0.5	0.3	0.4
Internal – general profile	6.5	7.2	5.2	4.5	2.8	1.6	1.8	1.6
Neurology	9.6	9.2	3.9	4.8	3.9	2.7	3.9	2.6
Psychiatry								

Wards	2007	2008	2009	2010	Wards	2011	
						VAP	Pulmonary infections
ARICU	34.4	28.3	24.9	25.4	Anesthesiology and resuscitation (A&R)	14.6	18.7
ARICU-neurosurgery	11.8	10.8	28.0	39.0			
Medical ICUs	1.2	1.9	1.0	1.6	Intensive therapy (IT)	5.0	7.9
Pediatric ICUs	3.7	3.6	7.0	7.1			
Surgical-general profile	0.6	0.4	0.4	0.5	Surgery	0.03	0.3
Orthopedics and traumatology	0.2	0.1	0.3	0.1	Orthopedics and traumatology	0.0	0.1
Neurosurgery	1.5	1.4	2.0	1.9	Neurosurgery	0.0	0.7
Cardiovascular surgery	3.2	2.9	2.6	2.0	Cardiac surgery	1.2	5.6
					Vascular surgery	0.07	0.0
Urology	0.3	0.1	0.1	0.1	Urology	0.0	0.08
Pediatric surgery	0.6	1.2	1.1	1.6	Pediatric surgery	0.6	0.9
					Septic surgery	0.0	0.0
					Thoracic surgery	0.7	3.9
					Lastic surgery	0.0	0.0
					Facio-maxillary surgery	0.0	0.0
Burns	5.2	1.4	2.9	4.9	Burns	0.0	5.0

Table 9: Incidence rate of vap and pulmonary infections (per 1000 patients discharged) in resuscitation. ICUs and surgical wards. 1999-2011.

Wards	SSIs												Wards	2011
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010		
ARICU	18.2	11.0	12.9	10.4	8.1	7.7	7.2	10.4	11.2	8.6	5.8	5.7	Anesthesiology and resuscitation (A&R)	6.3
ARICU-neuro surgery	17.9	2.5	19.3	7.0	20.1	7.9	11.6	2.0	3.1	2.0	0.2	4.6		
medical ICUs	0.1	0.0	0.1	0.1	0.1	0.0	1.6	0.0	0.0	0.1	0.0	0.0	Intensive therapy (IT)	2.7
pediatric ICUs	4.7	13.6	3.3	27.9	3.8	3.7	1.3	1.0	0.2	1.6	4.8	6.0		
Surgical- general profile	8.7	10.7	10.3	7.6	7.3	6.9	8.7	9.9	8.9	7.8	8.4	8.7	Surgery	9.4
Orthopedics and Traumatology	8.6	7.0	6.3	6.8	6.5	4.6	4.9	6.4	6.7	4.6	5.2	6.1	Orthopedics and traumatology	5.7
Neurosurgery	6.9	7.0	6.7	8.1	4.6	3.4	3.9	5.4	3.5	2.4	3.2	2.4	Neurosurgery	2.6
Cardiovascular surgery	17.1	14.0	9.6	8.8	8.6	6.5	4.5	5.6	4.2	4.2	4.7	5.0	Cardiac surgery	4.2
													Vascular surgery	11.3
Urology	6.0	6.5	6.3	7.5	5.7	3.8	4.9	4.5	3.4	3.2	2.8	2.5	Urology	2.0
Pediatric surgery	4.5	4.9	4.3	3.4	2.8	2.6	6.3	5.9	8.3	5.6	5.9	3.7	Pediatric surgery	4.2
													Septic surgery	23.4
													Thoracic surgery	6.7
													Plastic surgery	3.9
													Facio-maxillary surgery	1.8
Burns	46.7	35.2	47.2	40.2	37.3	40.5	31.9	36.8	26.0	17.2	21.7	29.7	Burns	37.9

Table 10: Incidence rate of SSIs (per 1000 patients discharged) in resuscitation. ICUs and surgical wards. 1999-2011.

Wards	UTIs												Wards	2011
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010		
ARICU	14.3	13.3	12.5	13.8	10.9	10.5	8.6	15.3	14.2	13.5	10.2	8.8	Anesthesiology and resuscitation (A&R)	13.5
ARICU-neuro surgery	36.2	54.8	22.2	21.7	11.0	23.6	29.0	15.4	12.9	7.1	15.3	25.7		
Medical ICUs	0.4	0.9	0.6	0.4	1.1	0.5	0.5	1.2	2.0	1.3	0.7	0.6	Intensive therapy (IT)	2.3
Pediatric ICUs	7.9	7.5	2.1	3.3	1.3	1.6	6.3	11.6	7.6	5.5	5.0	4.2		
Surgical- general profile	0.6	0.9	0.9	0.8	0.9	0.5	0.6	0.7	0.7	0.7	0.6	0.9	Surgery	0.9
Orthopedics and Traumatology	0.4	0.8	0.6	0.7	0.6	0.5	0.7	0.9	0.6	0.6	0.6	0.6	Orthopedics and traumatology	0.6
Neurosurgery	6.9	7.1	6.8	4.2	3.5	4.3	3.1	4.1	3.9	2.4	2.2	1.0	Neurosurgery	1.7
Cardiovascular surgery	0.4	0.1	1.5	2.1	3.5	0.7	3.6	1.4	1.5	0.8	1.6	2.4	Cardiac surgery	5.5
													Vascular surgery	0.4
Urology	33.9	32.7	32.0	25.3	23.9	23.9	27.9	25.3	20.9	22.9	17.2	17.2	Urology	13.1
Pediatric surgery	0.3	0.3	0.1	1.1	0.7	0.1	0.3	0.9	0.9	0.1	0.4	0.0	Pediatric surgery	0.5
													Septic surgery	0.9
													Thoracic surgery	0.4
													Plastic surgery	0.0
													Facio-maxillary surgery	0.0
Burns	17.3	18.9	30.2	11.3	14.3	5.0	3.7	5.8	4.0	3.2	4.0	4.9	Burns	12.0

Table 11: Incidence rate of UTIs (per 1000 patients discharged) in resuscitation. ICUs and surgical wards. 1999-2011.

SSIs: All surgeries report SSIs as a basic nosocomial complication: These infections constitute the major part of the reported infections, varying from 11%-urology, 13%-cardiac surgery to 30%-burns, pediatric surgery, neurosurgery, 50%-thoracic surgery, plastic surgery, 70-80% general surgery, orthopedics and traumatology, 82% facio-maxillary surgery, 86%-vascular surgery, 96%-septic surger*. Wards with definitely higher incidence are the burns units-38%, septic surgery-23% and vascular surgery-11%, while in the other special surgeries the rates are within lower limits 2-9%, ARICUs/ICUs-6/3% (Table 10).

UTIs: They comprise the greatest part (78%) of the reported infections in the urological wards and 18%/10% in risk wards as anesthesiology and resuscitation/burns units*, but the rates are analogous-resuscitation/urology-13/13%, burns-12%, indicating similar level of the infections among the A&R and burns units patients,

and the level of the infections among patients of the urological wards with urological problems (Table 11). The rates are presumably dependent and specifically related to urinary catheterization procedures (indwelling catheter) performed in these types of wards.

Sepsis: The 2011 notified cases comprise 11% of the NI reported by the anesthesiology and resuscitation, about 20-21% by the intensive therapy (ICUs), cardiac and pediatric surgery, 18%-burns units, in the rest surgical wards the percentages vary considerably between 0-9%*. The risk of septicemia outlines as a highest one in the burns units-22%. The official registration data, based on adequacy of the reporting, indicate an incidence in A&R/IT/cardiac surgery of 8/5/6%, pediatric surgery-3%, the rest surgery profiles, 0.0-0.5% (Table 12).

Two other categories of infections are considered of special importance for the A&R, the IT, and the surgery as follows:

Wards	Sepsis												Wards	2011
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010		
ARICU	12.4	8.0	9.5	6.8	3.8	7.6	6.9	6.0	9.8	5.8	5.8	5.7	Anesthesiology and resuscitation (A&R)	8.0
ARICU-neurosurgery	6.4	1.5	17.2	9.8	19.6	15.7	12.8	7.2	6.3	7.1	22.6	27.1	Intensive therapy (IT)	4.9
medical ICUs	0.8	0.8	0.4	0.2	0.2	0.0	0.2	0.3	0.2	0.2	0.1	1.0		
pediatric ICUs	15.4	8.0	3.7	2.5	2.5	4.3	5.8	6.6	2.9	5.5	15.1	9.9	Surgery	0.3
Surgical- general profile	1.2	0.8	0.8	0.1	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.2		
Orthopedics and Traumatology	0.1	0.0	0.1	0.1	0.2	0.1	0.1	0.0	0.1	0.1	0.0	0.0	Orthopedics and traumatology	0.0
Neurosurgery	0.6	0.5	0.6	0.3	0.3	0.4	0.3	1.2	1.2	4.2	2.3	1.5	Neurosurgery	0.7
Cardiovascular surgery	2.4	0.7	3.2	3.4	4.1	1.3	1.4	0.9	1.0	1.1	0.7	1.1	Cardiac surgery	6.2
													Vascular surgery	0.3
Urology	0.7	0.7	0.5	0.3	0.3	0.5	0.5	0.3	0.2	0.2	0.3	0.5	Urology	0.5
Pediatric surgery	0.9	1.5	1.8	0.6	0.6	0.8	0.4	0.5	0.5	0.3	1.1	1.9	Pediatric surgery	2.9
													Septic surgery	0.0
													Thoracic surgery	0.2
													Plastic surgery	0.0
													Facio-maxillary surgery	0.2
Burns	21.6	21.9	26.0	28.4	22.1	17.9	7.5	7.9	9.6	8.2	6.4	9.9	Burns	21.9

Table 12: Incidence rate of sepsis (per 1000 patients discharged) in resuscitation, ICUs and surgical wards, 1999-2011.

Intra-abdominal infections, as complications of operative procedures, related to a risk of high mortality rate, and infections of the cardiovascular system (phlebitis, thrombophlebitis to the greatest part, related to vascular devices). In the course of the period are reported single cases, the registration being improved in the last year: intraabdominal infections-5% of the infections in resuscitation, ICUs, general surgery, and 11%-pediatric surgery; cardiovascular system infections-22% in neurosurgery, 7% in cardiac surgery, 3-4% vascular, pediatric surgery, 2%-resuscitation, ICUs, general surgery*.

Discussion

The adopted in the country official registration system sustains the responsibility of the medical personnel on the problems of NI surveillance and control. CIS-NI provides considerable generalized and non-complicated information about NI distribution on the basis of the official records, processed in the national health information center.

The analysis of the overall NI incidence rates is indicative of a comparatively similar level of the registration by years in the course of the period observed-1999 to 2011. When calculating nosocomial infections incidence rate we utilize for the present a more general denominator (patients discharged), while some studies and the reference data of National Nosocomial Infections Surveillance System, USA (NNIS), subsequently National Healthcare Safety Network, USA (NHSN), engage more precised indices in the form of percentiles [15,16]. The recommended incidence rate calculation is per 1000 patient-days: as regards VAP-ventilator-days; vascular catheter related bacteremias-central line-days, umbilical catheter-days respectively; UTIs-urinary catheter-days. It is evident that no comparison can be made with these internationally approbated and adopted indices, but the calculated on a more general basis (per 1000 patients discharged) incidence rate is nevertheless a comparable by years morbidity rate index, while the percentage (frequency distribution) does not allow such type of interpretation.

There exist real possibilities for improving the feed-back to the wards by ensuring additional links to the system for the comparison of indices, treating the care for high-risk patients, i.e. undergoing risk procedures. These data should be strictly defined by speciality of the wards, i.e. patients undergo original data of the wards with the generalized data of the wards of similar activity (speciality), e.g., A&R units differentiated by their affiliation to the specific surgery ward, IT (ICUs) units-strictly differentiated by intended activity. There should be used comprehensible and reliable statistical criteria adjustable to the medical expertise in case of need.

The introduction of VAP in 2011 as a separate category established a 5% percentage of this infection of all the NI notified in the country. As a matter of comparison Kimberly-Clark Health Care clinical practice guidelines indicate a considerably higher percentage of VAP amounting to 15% of all nosocomial infections, and 24% to 27% of the infections acquired in coronary artery surgery and medical intensive care units (mICUs) respectively [17]. The initial incidence data for our country as of 2011 vary within the limits of about 15% for A&R, 5%-IT, 1,2%-cardiac surgery, and single or no cases notified by all the other special surgeries. The definite rates of VAP should be followed up in the units engaged with attending of intubated patients, and by this reason specifically subject to control.

The microbiological diagnostics is of substantial importance for the NI control in two respects:

The rapid and accurate diagnostic tests provide a possibility for correct treatment of the patient at the onset of infection; the microbial dissemination, most often referring to multiresistant bacteria, is prevented [18]. The distribution of the isolates in the microbiologically identified infections (total number of isolates) in the country is conformable to references data, *E.coli* and *S. aureus* being the principal etiologic agents. The unconfirmed and unexamined microbiologically infections, however, comprise a non-negligible percentage 3-10% of the reported VAP, SSIs, UTIs and sepsis respectively, more than

40%-of LRTIs cases, and more than 80% of cardiovascular infections. The improvement of the diagnostics through equipment with rapid tests, and the strict requirement for microbiological sampling and testing, antibiogram including, of any case of proved serious impact over the underlying disease, would eventually contribute to a better microbiological diagnosis and treatment of patients.

The examination of the dynamics of the indices for the two distinguished subcategories of wards revealed some serious weak points. For instance the low level of registration in NICU with no reported infections in 2011 may be considered unjustifiable in view of the lifesaving invasive manipulations performed in these high risk neonatal units as umbilical vein catheterization (umbilical catheter), intubation or continuous positive airway pressure (CPAP) in newborns with asphyxia and/or respiratory distress syndrome (RDS), and other risk procedures as gastric aspiration, urinary catheterization etc.

The cases of sepsis report bacteremia, without indicating, however, its origin (primary, secondary), and especially its relation to installed vascular device for central or peripheral venous catheterization. The available information may be considered indicative, though to a great extent dependent on adequate registration. The data in the course of the period 1999 to 2011 demonstrate the importance of these infections for the burns units, resuscitation wards, the neurosurgical resuscitation (data up to 2010), ICUs, cardiac and pediatric surgery.

Conclusion

The official registration system provides reliable information on a national level for the purpose of NI surveillance and control. The system interpretes the original data of the wards in basic indices as incidence rates and microbial isolates distribution. This official database reflects the efforts in the sphere of NI prevention and control. Possible additional links to the system would contribute to direct comparisons of indices regarding the care for patients undergoing risk procedures.

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