MICROBIOLOGICAL INDOOR AIR QUALITY ASPECTS ON HOSPITAL FACILITIES

Introduction

Nosocomial infections are referring to infections which are obtained by a patient or by a healthy person, in a medical or social institution, besides the characteristic manifestations of the incubation or the beginning of the pre-existing diseases (1).

Most of the cases are produced by antibiotic multi resistant bacterium: Staphylococcus aureus- methicillin-resistant, Pseudomonas aeruginosa, Escherichia coli, Klebsiella pneumoniae. While bacterial resistance is clearly the major threat, viral and fungal resistance could become important because of the small number of therapeutic options for these pathogens. Herpes viruses with acquired resistance to acyclovir have emerged as problems, particularly in HIV-infected patients. Candida spp with intrinsic resistance to azole antifungal agent and to amphotericin B have emerged as problem pathogens in oncology units (2).

Many epidemic outbreaks of NI in hospitals from Australia, Europe, USA and Japan where caused by roots of S. aureus, which ruling of qacC or qacA genes explains the resistance of antibiological and desinfectant substances (3).

Summary:

Hospital infection prevention and control becomes, during the large scale antibiotic use era, more difficult requiring measures to address the whole chain of determinants and adjuvant factors involved in the nososcomiality in order to prevent and reduce the associated health risk. A hospital infection control survey investigating both the hygienic and sanitary condition (crowding, ventilation) and microbial quality of air and also critical surfaces. The results revealed that the total number of germs for 37 C/cm³ of air, varied between 227-5279, exceeding the sanitary limits in about 73% of all investigated spaces from the five hospital from Bucharest.

Keywords: hospital infections, overcrowding, air quality, prophilaxy

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All over the world is considered that the morbidity and lethality by these infections is under evaluated. In France, in each year there are between 600,000 – 1,000,000 cases with over 10,000 deaths (4).

Studies made in Germany present an early average of NI incidence of 4-6%, with a high weight of Staphylococcus aureus- methicillin-resistant.

Over the past 25 years, CDC’s National Nosocomial Infections Surveillance (NNIS) system has received monthly reports of nosocomial infections from a nonrandom sample of US hospitals. In 1995nosocomial infections cost $4.5billion and contributed to than 88,000deaths-one death every 6minutes(5)

In Romania the number of NI cases varied between 1,500-2,000 (1969), over 30,000 (1988) and 50,000-60,000 (2000). Most of the cases were respiratory, digestive localizations, surgical wounds and urinary tract.

In the etiology of NI infections, the factors and mechanisms which characterize the immuno-compromised host are: deficit of the cellular immunity, deficit of the humoral immunity, absence of spleen, the compromis of anatomic defence shields (6).

Hospital infections, have had represented and still are representing a public health priority issue, historically

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associated with hospital functioning, and still influencing the patients efficiency and efficacy of the treatment, wellbeing and even life. Consequently mitigation measures from sterilization, antibiotics and disinfectant large scale use combined with systematic surveillance of hospital germs, have been introduced contributing to significant reduction of number of registered hospital infections. But, simultaneously, the newly invasive diagnosis procedures, huge, efficient hospitals development, high occupancy rate, are contributing to a new rising of the hospital infection number and severity.

Hospital infection and nosocomial infection outbreaks are associated to multiple causes either related to medical practices and procedures but also to many other administrative, that make the management interventions complex and difficult. In this condition, an adequate management including all the measures from the basic sanitary condition as: avoiding inpatients overcrowding, respect of functional flows, clear rules and spaces for patient visitation, clear roles and responsibilities for hospital infection prevention and control, monitoring and reporting, combined with the mechanical cleaning, washing and disinfecting measures, must be put in place in any hospital. Unfortunately, the large scale availability and use of the antibiotics and disinfecting products are prevailing to use of the simplest and efficient hygienic preventive measures.

The control of the appliance and efficiency of the prophylactic measures for infection prevention is a full time responsibility both of each practitioner, but especially for the surveillance and control of nosocomial infection hospital body. The epidemiological risks assessment is carried out in a coherent legislative framework setting the laboratory control procedures for the efficiency of sterilization, disinfection, and cleaning process within the critical points of the hospital. In order to identify and address all the potential risks for hospital infection. In this context the lab microbiological control is one of the central pillars of nosocomial infection prevention and control.

Briefly the increased frequency of hospital infection has a multifactor etiology, been influenced by factors related to:

- newly invasive diagnostic and treatment medical procedures;
- antibiotic resistance and increasing pathogenicity of hospital germs;
- patient increasing receptivity,
- long, sometimes less justified, length of hospitalization
- and last but not least neglected sanitary rules as functional circuits, cleaning crowding.

Consequently all those factors should be adequately surveyed and addressed in order to reduce and prevent their contribution in acquiring hospital infection. The results of other surveys on hospital infection reveal as the most important infection sources and chains: the indoor air, the lingerie, medical equipments, objects and surfaces, food.

Among the most effective preventive measures in preventing hospital infection occurrence, could be mentioned:

- functional circuits assurance,
- age group separation in children hospitals,
- disease related group separation in adults hospitals,
- continuously cleaning and disinfection,
- appropriate sterilization and sterilization control,
- hygienic skills promotion both for medical practitioners but also for patient.

Hospital infection epidemiological intervention, among the most important measures includes: epidemiologist involvement, early detection of nosocomial infection, ill person isolation, contacts identification and observation, germs identification and transmission chain surveillance and mitigation.

**Material and methods**

The study carried out evaluated both the hygienic and sanitation condition and microbiological air quality in 5 Bucharest hospitals with different specializations: infectious diseases, rheumatology, neurology, nephrology, and obstetrics. Microbiological measurements were performed both for air quality and surfaces for each hospital in three hospital patient rooms, totally in 15 hospital rooms. The air samples were collected in 3 points of the room by sedimentation (window and door sampling point) and aspiration (center of the room) in presence of hospitalized patients. The determination on microbiological contamination of the surfaces was made by the method Dip Slide (OXOID)

The total number of sample microbiological analyzed was of 130.

The sanitation conditions were recorded by trained medical personal, from the study team.

**Germs identification and sampling methods**

The germs sampling was made as described above, by a standardized procedures for all samples, on specific culture media, then incubated 24 hours at 37°C, and the
The total number of germs was calculated by identification and isolation was made by Omeliansky method.

**Results**

One of the most important hygienic features of the hospitalization conditions investigated was the volume of air available for each patient. The figures for this indicator, in cubic meters per bed, for each type of investigated hospital are presented in figure 1.

It reveals the only in the nephrology and infectious diseases investigated hospitals the sanitary norms (20 CM/bed) in accomplished. The opposite, the worst situation, despite the decreasing of numbers of births was registered in the obstetrics hospital; only the mean value was about 10 m$^3$ air / bed.

The microbial air quality exceeds the sanitary norms of 600 germs/ m$^3$ of air for the total number of germs at 37°C for 73% of all investigated rooms. The rage of values varies between 227 germs/ m$^3$ of air in infectious diseases hospital to 5279 germs/ m$^3$ of air in neurology hospital, according to figure 2.

The type of germs from the investigated air samples revealed the following prevailing type, according the table no. 1

The results of determination on microbiological contamination of the surfaces made by the method Dip Slide (OXOID), shows up a low contamination for most of the investigated sites, and medium one for the rest of the location. The method use allows identification of TNG: NTG at 37°C, Staphylococcus aureus, Enterobacteriacee, Pseudomonas aeruginosa. The results for the surfaces contamination are presented in table 2.

**Conclusions**

- all the investigated sites exceeds the limits for general microbial contamination
- about ¼ of total investigated locations are in accordance with sanitary existing regulation
- the microbiological exceeding is closely related to patient overcrowding, and lack of compliance for the air volume per patient.
- the rooms with its one toilet facilities ensure better condition for individual hygiene, contributing to reducing the infectious risks.

**Table 1.**

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<thead>
<tr>
<th>Investigated hospital</th>
<th>Pathogen germs identified</th>
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<tbody>
<tr>
<td>Infectious diseases</td>
<td>absent</td>
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<tr>
<td>Rheumatology</td>
<td>Staphylococcus aureus</td>
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<tr>
<td>Neurology</td>
<td>Staphylococcus aureus</td>
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<tr>
<td>Nephrology</td>
<td>absent</td>
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<tr>
<td>Obstetrics</td>
<td>absent</td>
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</tbody>
</table>

**Table 2.**

<table>
<thead>
<tr>
<th>Investigated hospital</th>
<th>Surfaces contamination</th>
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<tr>
<td>Infectious diseases</td>
<td>$10^3$</td>
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<td>Rheumatology</td>
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<td>Neurology</td>
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the old buildings, poses seriously maintenance difficulties and usually presents higher microbial concentrations, over the recommended thresholds. the prevention and control measures for hospital infection should address all the etiological chain from hygienically hospitalization features assurance to sterilization and disinfection adequate measures. selection of diagnostic and treatment procedures associated to lowest risk of hospital infection strengthening the nosocomial infection surveillance, reporting and intervention system must be considered further a priority.

References:
2. Robert A. Weinstein – Infection control in the hospital- Principle of internal medicine, 2001