



Review Article

Environmental Epidemiology “An emerging proposal to reduce nosocomial infections”

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ABSTRACT

Keywords

Environmental quality; aero-microbiological; nosocomial infections; environmental epidemiology; quality of attention.

Environmental epidemiology is a further need in the control of nosocomial infections, poor environmental quality aero microbiological tertiary hospital is one of the possibilities of posing a risk to trigger nosocomial infections, usually clinical epidemiology and surveillance does not obey a represents the environmental reality from aerosols, samples are only surfaces, air conditioning and patient records, this allows the identification of the risks arising from the presence and distribution of microorganisms transported aircraft, microbiological volume calculation transportado/m³, knowledge of their resistance profiles an los microbes and heavy metals. Deficient aero-microbiological environmental quality at a third level hospital constitutes one of the possibilities of presenting risks to trigger nosocomial infections, epidemiological surveillance and environmental epidemiology, both, represent a real, additional and necessary towards inter hospital epidemiological surveillance which normally its carried out in hospitals independently of the hospital level. The environmental surveillance is a necessity that allows tracking of bioaerosol variables within wards and anticipate risks and the presence of nosocomial infections, allows for correlation between environmental microorganisms and carrying the patient. The hospital aerosol monitoring, study or environmental surveillance allowed to interfere in the reduction of nosocomial infections in the generation of control strategies and ensure sanitary hygiene controlled environment to improve the quality of care for people or users of the medical services.

Introduction

Inter hospital quality ad nosocomial infections are still a serious public health

problem of economic and social importance. Its clinical importance is

supported on high rates of morbidity and mortality, and affect life years which become potentially lost (Norma Oficial Mexicana,-017-SSA2, 1994; Manual de Procedimientos para la Vigilancia Epidemiológica de las Infecciones Nosocomiales, 1997; Ponce de León RS, Macías *et al.*, 2000).

It is important to point out that generally, hospitals count with an epidemiology division or department, the execution of this work normally relies on medical – clinical epidemiology and thus it is known that hygienic and sanitarian measures of the hospital standard cares of the health professionals, their education for health and the same entitled population accounted, the flow of the patients, among other factors which intervene in the generation of a characteristic inter hospital environment and this makes environmental epidemiology and inter hospital environmental epidemiological surveillance acquire a value of use that at the same time determine strategies or specific actions to diminish nosocomial infections.

It is important to establish that when microorganisms face stressful environments on their struggle for surviving, synthesize a type of proteins denominated compatible solutes, which allow them to resist osmotic stress to which they are submitted and in a way those increase their capacity of virulence and become more virulent (Rosas *et al.*, 1994). In reference to O.R a clean atmosphere is required in order to avoid further infections to the surgical intervention (Pérez-Castro *et al.*, 1987) and on the same way the microbiological control on areas of pharmaceuticals production (Joames *et al.*, 1993).

It has been demonstrated that the concentration of 1×10^3 bacteria high negative/m³ in the environment cause inflammatory effect of the mucus membranes, which represents a concentration of 0.1 mg/m³ of endotoxin. (Rosas *et al.*, 1994; Buttner *et al.*, 1997).

In reference to the recuperation of bacteria by cubic meter, it is known that if one cultivation box that contains TSA Trypticase soy agar, it is exposed for 15 minutes and impact them only 1 UFC/m³. It is said that a presence of at least 38 UFC/m³ is required.

For extension, if we multiply the number of impacted UFC in the cultivate box by the factor 38, we will obtain an approximate estimation of the bacteria concentration for cubic meter (Rosas *et al.*, 1994; Joames *et al.*, 1993). Then, under this estimation, it is possible to calculate the quantity of bacteria at which hospitalized people are exposed in a controlled but contaminated area (Joames *et al.*, 1993), in the case of a hospital, a pharmacy or any other area of the hospital. Environmental monitoring of sprays generated at the hospital represent a useful methodology to evaluate the environmental impact of the air, it is defined as the recollection, analysis and systematic evaluation of environmental samples, such as air, water or aliments looking for microbiological contamination (OPS/OMS, 1995).

Its important to point out that regarding the collection of environmental samples and in reference to the sampling of microorganisms, diverse ways to obtain the samples from the environmental air exist, highlighting the sediment ones, in the petri box with TSA Trypticase soy agar for 20 minutes exposition for O.R or

in TSA Trypticase soy agar for 15 minutes exposition for controlled areas as the best way for microbial recuperation (Joames *et al.*, 1993).

Through this methodology it has been possible to recuperate entire bacteria from sprays which in a particular way showed patters of resistance to antimicrobial and to heavy metal and which due to their genotypic characteristics show incremented virulence (Raygoza Anaya and Ruvalacaba Ledezma, 2000), so the presence of this type of microorganisms could represent risks for health. It is known that bioaerosols could impact human health (Raygoza Anaya and Ruvalacaba Ledezma, 2000; Rosas *et al.*, 1994).

Other sampling methods are known, among them, one of the most important which could allow estimating the risk derived from exposition to microorganisms is (MA) MonitorAnderssen; this represents a mechanical technique in 15 minutes of exposition in agar, malt extract and Trypticase soy agar (Rosas *et al.*, 1994).

In addition, an alternative method has been known, in case of not being supplied with the MA. The aero bio collector “air IDEAL™”, serves to conduct this type of samples and research projects and which allows environmental and microbiological monitoring and which operates according to the impact principle under the norm ISO/DIS 14698-, taking air 100 lt/min with an impact speed of <20 m/sec. It collects particles whose diameter oscillates between 3 and 10 µm, it is compatible with the sampling of 65/70 y de 90 mm Rodac boxes (RHOVE, 2012). It is even reasonable that a hospital counts with this supply.

Up to the moment, the environmental inter hospital monitoring are conducted collocating a Rodac box in the exits of the air conditioning and in the superficies without being able to say the volume of exposition.

Nosocomial infection rates at third level hospitals maintain an average of 4.8/100 egresses at a national level, according to the data base RHOVE in 2008, same that varies according to the site of infection (RHOVE, 2009).

This leads to considerate the important development of the inter hospital environmental epidemiological surveillance, in other words, of applied environmental epidemiology and in interaction with medical- clinical epidemiology that allows evaluating inter hospital risks and trying to combat damage and prejudices that generate nosocomial infections.

Justification and insistence for the proposal

One of the unprotected, merely at a hospital level, has to do with the environmental health of the hospital environment; the lack of tracking from epidemiological surveillance and the lack of standardized patters concerning the management of the environmental quality make necessary that the third level of attention counts with patters and comparable parameters, evaluated from environmental sciences, where the quality of the hygienic inter hospital services could be effectively sustained and a positive impact that promotes the increase of the academic capability of the people in charge of executing epidemiological surveillance, not only medical- clinical, but also of risk evaluation from the inter

hospital environmental epidemiology, above all in what concerns a hospital of third level, where epidemiological surveillance is required in a constant-permanent and important basis.

It is known that when bacteria live in spaces where the concentration of contaminating agents, included antibiotics, they are marinated in constant aggressiveness, they can produce some protein substances known as compatible solutes, that on one side allows them to survive in those environments and at the same time causes stress to which they are submitted in a way, this facilitates their most virulent action, virulence which they express when they find a guest that gives them accommodation and that provides the nutritional conditions to cause illness, this most of all derived if their viability is more effective, even in human beings concerning the cultivation means as in the blood agar, 110 agar, staphylococcus, where apparently are captured and don't grow, this means they are not viable, or better said, capable of being cultivated.

Although (Joames and Almazán, 1993) has already pointed out that the best cultivation mean for the bacterial recoverability proceeding from air is the TSA Trypticase soy agar, reason for which this substance is proposed when conducting this type of epidemiological surveillance. Through constant monitoring, this project will employ TSA.

Antibiotics as well as other contaminated substances from the inter hospital environment represent a source of exposition for bacteria, meaning that an environment charged of medicine and chemical substances are provoked aggressiveness, to which bacteria react generating resistance profiles and at the

same time increasing their virulence (Ruvalcaba Ledezma and Cortés Ascencio, 2013).

The bacteria located in contaminated environments and with specific resistance profiles mean their usefulness as bio indicators of microbiological quality (Ruvalcaba-Ledezma, 1996). This will allow preventing and designing strategies to avoid the beginning or development of nosocomial infections and even of epidemic outbreaks.

Conducting a reach project of this size at an inter hospital level supports the academic basis yet incipient to effect epidemic surveillance, considering the environment supported by the aerobiological methodology or environmental epidemiology, methodology that deserves a transcendental collaboration to the environmental epidemiology; in that way it could be possible to obtain the collection and register of risk factors in a systematized and constant way. Their collection in the data base would facilitate the opportune analysis, with the finality that this allows qualifying and quantifying the inter hospital environment and pursuing standards of environmental quality. At the same time, this project will allow to interpret a subjective reality up to the moment concerning the collect of inter hospital microorganisms as a model of inter hospital environmental epidemiological surveillance, that at its time could affect diminishing nosocomial infections and economic costs for such health services (Sudharsanam *et al.*, 2012).

Conducting scientific research projects at the third level of attention, would allow to finally count with a technical- scientific methodology to point out aerobiological

quality of the hospitalization services, through the attention that environmental sciences represent at an inter hospital level, where evaluation of knowledge is applied through the health personnel and the users, the monitoring of hygienic - sanitary applied measures and their correction, if necessary, including the actions of the cleaning personnel of the hospital by orientating them and keeping control of the chemicals the employees use every day.

Environmental monitoring results to be an effective methodology to determine the aerobiological aero transported quality, its resistance profiles to antibiotics and the microbiological recuperation for their study from the perspective of their cellular viability, as well as the existent correlations between this type of microorganisms and nosocomial infection.

The challenge for this research proposal is called environmental epidemiology hospital

It is known 1×10^3 that bacillary morphological bacteria in the air of controlled areas represent a risk for human health, that these bacteria get stressed and synthesize protein to survive in adverse conditions, but also that this situation allows them to be more virulent, modifying their metabolism and their form even back to favorable conditions (Sheyby L Sergey, 1995; Roszac and Colwell, 1987; Bruce Lighthart and Brenda T. Shaffer, 1995; Cambell, 1987). Those adverse conditions could occur in the community or in the hospital, though *E. coli* and *K. pneumonia* strains, which produce beta-lactamase, have been isolated with more prevalence of inter hospital strains rather than community ones (Navarro-Navarro *et al.*, 2011).

The air does not include the aero transportation of microorganisms not only transmitters of respiratory diseases, but of a wide variety of microorganisms between which are the saprophytes and aerolite products, fragments of cellular membranes, scourges and genetic material, metabolites, volatile organic compounds, endotoxins and mycotoxins, in the internal air can contain microorganisms that affect the human health and the environment, associated with bioaerosols.

In order to consider the environmental quality, bio sprays can contain particles between 0.5-30 μm diameter, the concentration of microorganisms located in bioaerosols varies depending on the dissipation and deposition, they are associated with particles depending of the size, density, humidity, temperature, when they are extreme they intervene as environmental factors and favor the variety of microorganisms, fungus, bacteria, virus, amoeba cysts among other agents. During their transportation, microorganisms get stressed and die, but the one that survive generate adverse damages in human health, the agents get installed in the human gest through exposition mechanisms and entrances as indigestion, inhalation and contact through the skin, are the main roots of exposition for the human.

Human beings inhale approximately 10 m^3 per day and can give room in their alveoli for particles of 1 to 2 μm diameter; as a result of this they will present adverse health status, such as, severe infections, asthma, hypersensitiveness, pneumonia and other associated with the exposition to bioaerosols (Stetzenbach, 1997; Rosas *et al.*, 2004; Hilda Kruce and Henning, 1994; Ruvalcaba Ledezma, 2013; Sudharsanam *et al.*, 2012).

For the quantitative collection of bio sprays sampled, there are three the methods mainly implemented: impact, liquid mean, filtration by gravity; to conduct studies of microscopy biochemical, immune essays and PCR.

The challenge consists on looking for answers to unknowns as following:

What is the aeromicrobiological aero transported quality in the hospitalization services, as well as their correlation with the incidence of etiologic incidence of etiological agents related to nosocomial infections and their main risks factors identified in a third level hospital?

For instance:

Has the maintaining and cleaning personnel or the person in charge of carrying out the application of hygienic-sanitarian measures received training on the usefulness of chemicals and inter hospital cleaning processes?

Objective

One of the fundamental objectives to carry out this type of investigation are mainly: determining the variability of inter hospital aero microbiological recuperation and its correlation with the incidence of etiological agents related to nosocomial infections, as well as their main risks factors identified though the standardized environmental epidemiological surveillance system

The proposal to reduce the impact of nosocomial infections

The proposal is to carry out research projects from the epidemiology and their

design starting from a longitudinal descriptive study, which through sampling of air in cultivate boxes added with TSA Trypticase soy agar, exposed for 15 minutes in an open box (figura1, 2), surveillance of the environmental aero microbiological quality, standardizing sampling methods, as well as proposing sampling of the air of the hospital rooms by means of a sampler that simulates the functioning of the respiratory system of humans denominated as sampler Andersen (MA) and in another sampler of air, as it is air sampler IDEAL™ and analyzing the collected information concerning nosocomial infections, microbial viability, invasive treatments, characteristics related to the etiologic agent: the microbial recovery, frequency of nosocomial infection, as well as etiological agent and resistance and sensitiveness to antimicrobial, resistance profiles to heavy metals as well as exploring in the health personnel the incidence of respiratory infections. It is fundamental to execute the environmental epidemiology in all the hospitals, obviously that the best quality of inter hospital attention and were we less expect to find the experience of suffering a nosocomial infection.

Every hospital requires the intervention of a department of division of epidemiology, not only clinical epidemiology but environmental inter hospital epidemiology.

Inter hospital environmental epidemiological surveillance intervenes in diminishing the nosocomial infections and implies and means that epidemiological surveillance requires of taking samples and environmental monitoring to describe and identify the risks of inter hospital aerosols.

Figure.1 Sampling of air in hospital for 15 minutes of exposition.



Figure.2 Air Sampling AST inside ward for 15 minutes exposure



Inter hospital environmental epidemiology through methodology and research actions and standardized monitoring allow the execution of hygienic- sanitarian measures. Train the health professional on the hand wash and on the exhaustive care concerning the transportation of their clothes, their working area and other spaces inside and outside the hospital.

Research in this direction will allow interpreting a subjective reality so far and adopt a model of environmental epidemiological surveillance have a positive impact on reducing nosocomial

infections, familial and social cost for those costs in the health sector.

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