

## Biosecurity and infectious diseases: contemporary challenges

## Biossegurança e doenças infecciosas: desafios contemporâneos

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## ABSTRACT

**Introduction:** Infectious diseases are a frequent object of study and interest for science. Thus, great advances have been obtained in the diagnosis, prevention and treatment of such diseases. The current theme of biosafety - actions designed to prevent, control, reduce or eliminate risks inherent in activities that can compromise human, animal and plant health and the environment. **Objective:** This manuscript will focus on the discussion of: standard biosafety precautions, vaccination for healthcare workers, pre-exposure prophylaxis (PrEP), and post-exposure prophylaxis for some respiratory and biological fluid transmitted diseases. **Method:** Literature review with articles that discuss about creation and maintenance of safety committees such as the Internal Commission for Accident Prevention (CIPA), Specialized Services for Safety Engineering and Occupational Medicine (SESMT), and/or the Commission for Hospital Infection Control (CCIH). **Results:** It is necessary to expand monitoring in biosafety, through cooperation between countries in risk analysis, prevention resources and control of infectious diseases. **Conclusions:** Biosafety norms are fundamental for the confrontation of infectious diseases and must be followed by health professionals. The construction of biosafety care is a collective ethical and social commitment of respect, trust and responsibility.

**Keywords:** biosafety, infectious diseases .

## RESUMO

**Introdução:** As doenças infecciosas são um objecto de estudo frequente e de interesse para a ciência. Assim, foram obtidos grandes avanços no diagnóstico, prevenção e tratamento de tais doenças. O tema actual da biossegurança - acções destinadas a prevenir, controlar, reduzir ou eliminar riscos inerentes a actividades que podem comprometer a saúde humana, animal e vegetal e o ambiente. **Objectivo:** Este manuscrito centrar-se-á na discussão de: precauções padrão em matéria de biossegurança, vacinação para trabalhadores da saúde, profilaxia pré-exposição (PrEP), e profilaxia pós-exposição para algumas doenças transmitidas por fluidos respiratórios e biológicos. **Método:** Revisão bibliográfica com artigos que discutem a criação e manutenção de comissões de segurança, tais como a Comissão Interna de Prevenção de Acidentes (CIPA), Serviços Especializados de Engenharia de Segurança e Medicina do Trabalho (SESMT), e/ou a Comissão de Controlo de Infecções Hospitalares (CCIH). **Resultados:** É necessário expandir a monitorização em biossegurança, através da cooperação entre países na análise de risco, recursos de prevenção e controlo de doenças infecciosas. **Conclusões:** As normas de biossegurança são fundamentais para o confronto das doenças infecciosas e devem ser seguidas pelos profissionais de saúde. A construção dos cuidados de biossegurança é um compromisso ético e social colectivo de respeito, confiança e responsabilidade.

**Palavras-chave:** biosegurança, doenças infecciosas.

## 1 INTRODUCTION

Infectious diseases have plagued mankind since the beginning of time, and for this reason are frequent objects of study and interest of science (AHMAD et al., 2020). Despite major advances in the diagnosis, prevention and treatment of such diseases, there are still numerous challenges, either by the multiplicity of pathological agents or by the unpredictable behavior of various diseases, especially those emerging and re-emerging. Climate change and population flux are pointed out as possible direct causes of changes in microbial diversity and

pathogen transmission. It is estimated that more than 40 infectious diseases have emerged in the past 40 years (ZHOU et al., 2019). We need to remember the relationships of all life forms, biotic and abiotic factors in the light of chemistry and ecology in timely relationships or not. Then, homeostasis according to Dajoz (1973) "the more complex the ecosystems, the greater their tendency to stability, that is, to an increasingly marked independence from perturbations of external origin. This tendency to stability is called homeostasis" (GUYTON, 1997).

The current theme of biosafety - actions intended to prevent, control, reduce or eliminate risks inherent in activities that may compromise human, animal and plant health and the environment (CARDOSO; SCHATZMAYR, 2003) - is directly linked to the prevention and transmission of infectious diseases, covering technical, administrative, educational, medical and psychological standards, aiming to protect health professionals and workers involved in the laboratory environment, who are exposed during their work activities (COSTA, 1996). The creation and expansion of biotechnological processes and genetic engineering have broadened the concept of biosafety internationally, also encompassing discussions on how these new techniques can affect the biodiversity and sustainability of the planet and life (MELLO, 2012).

Currently, good practices, new technologies in biosafety, the creation and revision of guidelines and manuals have significantly improved safety in laboratory environments, especially in the handling of microbiological materials, demonstrating an attempt to improve working conditions. Despite the institution of containment measures and knowledge of regulations and guides, accidental infections in exposure environments occur commonly, which shows that biosafety standards are not always efficient or applied correctly (PENNA et al, 2010).

Health professionals, by the very nature of their activities, have direct contact with patients and carriers of different etiological agents, making them more vulnerable to infection by pathogens and accidents involving risk of contagion. A cross-sectional study evaluated tuberculosis infection among health professionals in primary care and found a high prevalence of latent infection in the studied team and that the presence or absence of biosafety actions determined the health outcome of these workers (LACERDA et al, 2017). These data highlight the importance of training, capacity building, protocols, technique mastery, and qualification for health care workers in each proposed work activity.

The condition of vulnerability attributed to health professionals becomes even greater when the individual is unaware or does not master the basic rules of biosafety, or even when even aware of such rules, he assumes a risky behavior, acting recklessly, negligently or with malpractice in relation to potential accidents, becoming with this behavior a factor or potential

risk agent. According to SEGATA (2020), a constant attitude of preparation hovers over the present time, in which insufficient and superficial information is taken as being the truth and a foundation to justify inaccurate actions in the field of biosafety, escaping from precautionary and risk assessment practices. This political and social phenomenon affects not only governmental spheres but also individuals, especially health workers.

Discussions on the importance of biosafety and good practices by healthcare workers have been resumed thanks to recent phenomena, such as the discovery of HIV in the 1980s, the illness of healthcare workers by influenza viruses (H1N1 and H5N1), SARS in 2003 with an outbreak in China was controlled by biosafety measures leading vaccine studies to be put aside, the Middle East respiratory syndrome coronavirus (MERS-CoV) in 2012 and Ebola virus. Currently, with the pandemic of SARS-CoV-2, causing COVID-19, strict prevention and control strategies to minimize the rapid population spread of this pathogen are indispensable (DHAMA et al., 2020) and, there is still the problem of the possibility of exposure to occupational risk of health employees in the exercise of their work activity in an institutional environment in the health area and how to minimize it, impacting on quality of life.

The effectiveness of biosafety actions is the responsibility of all professionals involved in risk activities, collectively as well as individually. It is necessary that these professionals be properly instructed about the current guidelines, qualified to put them into practice correctly, and also able to deal with unpredictable accidents, since, even under ideal conditions, the risks can never be completely ruled out (PENNA et al, 2010). Moreover, we will bring to the debate the action of leaders, team, individual and collective, because if each player wants to perform his own game and establish his individual purposes, it is likely that there is no team and that these players are doomed to failure. As Rego (1988, p. 39) points out, "the level of knowledge can redound to success or failure of the communicative act."

This article will focus on discussing (1) standard biosafety precautions, (2) vaccination for healthcare workers, (3) pre-exposure prophylaxes (PrEP), and (4) post-exposure prophylaxes for some respiratory and biological fluid transmitted diseases.

## **2 STANDARD PRECAUTION**

It is the set of biosafety measures that must be applied in the care of every patient, regardless of suspected or not suspected infections. Some recommendations represent the basic care to avoid the cross transmission of infections between the health professional and the patient under his/her care, such as:

- I. Hand hygiene before and after contact with any patient, their objects and body fluids;
- II. Use personal protection equipment (PPE);
- III. Dispose of sharps or any contaminated material correctly and in appropriate locations.

The following table (Table 1) summarizes the standard precautionary recommendations in biosafety, detailing specific aspects on the use of Personal Protective Equipment (PPE).

Table 1 - Standard Precautionary Recommendations in Biosafety

Standard Precaution: Measure	Recommendation
Hand hygiene <sup>a</sup>	Wash with soap and water before and after contact with any patient, after removing gloves, after contact with environmental surfaces near the patient, and after contact with blood or secretions.
Gloves	Use when there is risk of direct contact with blood, secretions, mucous membranes or non-integral skin. They must be used immediately before contact with the patient and removed promptly after use, sanitizing the hands afterwards.
Goggles or <sup>d</sup> Face Mask ( <i>face-shield</i> )	Use when there is risk of contact with blood or secretions, for protection of the mucous membrane of the eyes, mouth, nose, clothes and body surfaces.
Sharps box <sup>e</sup>	Syringes <sup>b</sup> - needles, glass, vials, blades, and lancets must be disposed of in lidded, rigid containers that are resistant to puncture, breakage, and leakage.

Source: BRAZIL. Ministry of Health. Agência Nacional de Vigilância Sanitária. *Interventions and Measures for Prevention and Control of Microbial Resistance*. Brasília: MS, 2010. Table adapted from material available at [http://www.anvisa.gov.br/servicosaude/control/precaucoes\\_a3.pdf](http://www.anvisa.gov.br/servicosaude/control/precaucoes_a3.pdf).

BRAZIL. National Action Plan for the Prevention and Control of Antimicrobial Resistance in the Single Health Setting. MS 2018-2022. Secretary of Health Surveillance. Department of Surveillance of Transmissible Diseases. Brasília /DF, 2019.

**Comments:**

*a- Hand hygiene can also be done with 70% alcohol if the hands are not visibly dirty. It should be performed before contact with patients, after contact with intact skin, and after contact with inanimate objects or potentially contaminated surfaces. (BOLON, 2016), (CDC, 2002), (WHO, 2009).*

*b- The use of gloves is indicated for any procedures with risk of contact with blood and/or patient secretions, such as: blood, urine, and feces collection; bandages; intimate or bodily hygiene, catheter manipulation, parenteral drug application; peripheral or deep venous puncture; airway aspiration and orotracheal intubation; bronchoscopy; endoscopy; and odontological procedures.*

*c- The hoods are necessary in any situation where there is a possibility of contact with biological fluid (performing body hygiene and dressing large wounds).*

*d- The use of goggles or face shield, such as face-shield, is indicated during care with the risk of splashing biological material on the face, or in the preparation and administration of chemotherapeutic drugs.*

*e- Needles and syringes should never be disconnected and needles should never be recapped. The sharp materials must be discarded in rigid containers and must not exceed two-thirds of the maximum capacity. It is emphasized*

that other materials such as cotton, compresses, gauze and others must be disposed of in semi-transparent white plastic bags, identified with the biohazard symbol.

### 3 VACCINATION FOR HEALTHCARE WORKERS

Vaccination is the most effective means of preventing and controlling infectious diseases (ZHOU et al., 2019). In addition to the lasting protection generated by active immunization, vaccination reduces the transmission of infectious agents from non-immunized people to others, thus reducing the impact of the spread of infection. Thus, the vaccination of health care workers is an essential conduct both for the protection of these workers during their activities and for health care in general. *Chart 2* indicates the main vaccines indicated for healthcare workers.

Chart 2 - Main vaccines indicated for healthcare workers <sup>a</sup>

Recommended Vaccine	Scheme	Remarks
<b>MMR: measles, mumps and rubella</b>	<p>An immune individual is considered to be one who has received two doses of the MMR vaccine, with a minimum interval of 30 days between doses, after 1 year of age.</p> <p>In case of unknown or unvaccinated vaccination history, give two doses. Complete the schedule in individuals who received a previous dose.</p>	<p>The application of live attenuated vaccines to immunosuppressed and pregnant women is contraindicated. In exceptional cases and after careful evaluation of risks and benefits, it can be applied to these patients.</p> <p>There is no evidence that justifies a third dose as routine, but it can be considered in situations of epidemiological risk, such as mumps or measles outbreaks.</p>
<b>Hepatitis A, B or A and B</b>	Hepatitis A: two doses, 0-6 months schedule	The hepatitis A vaccine is indicated primarily for laundry workers, kitchen workers, food handlers, and laboratory researchers who handle the virus (CDC, 2006 hepatitis A).
	<p>Hepatitis B: three doses, scheme 0-1-6 months.</p> <p>They are considered a priority in Public Health and are available at the basic health Unit (UBS).</p>	Special hepatitis B vaccination scheme: immunosuppressed and chronic renal disease patients - double the usual dose, i.e. 2 mL = 40 mcg, in four intramuscular applications (scheme 0-1-2-6 months) (CDC, 2006 hepatitis B).
	<p>Hepatitis A and B: three doses, scheme 0-1-6 months.</p> <p>Combination vaccination against hepatitis A and B is an option and can replace vaccination against hepatitis A and B alone.</p>	<p>Serology 30-60 days after the third dose of vaccine is recommended for: health professionals, immunosuppressed and chronic renal patients. The individual who presents anti-HBs titer <math>\geq 10</math> IU/mL is considered immunized.</p> <p>For high-risk patients (immunosuppressed and chronic renal patients), annual serological monitoring is recommended: consider a booster dose when anti-HBs <math>&lt; 10</math> IU/mL.</p>
<b>Bacterial Triple - diphtheria, tetanus, and pertussis - adult type acellular (dTpa)</b>	<p>Apply dTpa regardless of previous interval with dT or tetanus (TT).</p> <p>With complete basic vaccination scheme: booster every 10 years with dTpa (acellular,</p>	<p>The pertussis vaccine is especially indicated for professionals in neonatology, pediatrics, and geriatrics.</p> <p>Unvaccinated and/or unknown vaccination history: one dose of dTpa and two doses of</p>

<b>Double adult type - diphtheria and tetanus (dT)</b>	triple bacterial adult type) or dT (double adult type) 10 years after the last dose.	dT in the schedule 0-2 -4 to 8 months.
	With incomplete basic tetanus vaccination schedule (less than three doses): one dose of dTpa at any time and complete the basic vaccination with one or two doses of dT, so as to total three doses of vaccine containing the tetanus component.	In both cases: if it is not possible to use the dTpa vaccine, replace it with the dT vaccine and vice-versa, completing three doses of the vaccine with the tetanus component.
<b>Varicella</b>	Two doses with an interval of four to eight weeks in between (Marin et al., 2007). For susceptibles: interval of 1 to 2 months.	Live attenuated vaccines are contraindicated for immunosuppressed and pregnant women. <b>It must be evaluated by the physician.</b>
<b>Influenza (Flu)</b>	Single dose annually. As long as it is available, the 4V influenza vaccine is preferable to the 3V influenza vaccine, including in pregnant women, because it provides greater coverage of the circulating strains. If the 4V vaccine cannot be used, use the 3V vaccine.	As long as it is available, the 4V influenza vaccine is preferable to the 3V influenza vaccine, including in pregnant women, because it provides greater coverage of circulating strains. If the 4V vaccine cannot be used, use the 3V vaccine.
<b>Meningococcal conjugate (ACWY/C)</b>	A dose should be administered, even in those who have already been vaccinated (in childhood or more than 5 years ago). The need for booster doses should be evaluated according to the epidemiological situation.	Whenever possible, the quadrivalent ACWY vaccine should be preferred in order to achieve a more adequate protection. In its absence, the meningococcal C conjugate vaccine must be evaluated. It is indicated for professionals working in bacteriology, in emergency services, who travel a lot, and in humanitarian aid/disaster situations.
<b>Meningococcal B</b>	Two doses at an interval of 30 to 60 days.	Meningococcal B vaccine should be considered by assessing the epidemiological situation.
<b>Yellow Fever</b>	One dose for people who live in an endemic area or for travelers to areas where the vaccine is recommended (according to international classification and the Ministry of Health,2018 <sup>b</sup> ).	There is no consensus about the duration of protection conferred by the vaccine. A second dose should be evaluated in areas of high epidemiological risk, considering the possibility of vaccine failure.

Source: *SBIIm Occupational vaccination calendar*. Recommendations of the Brazilian Society of Immunizations (SBIIm) - 2020/2021.

Source: Yellow fever: a guide for health professionals -/Ministry of Health, Secretariat of Health Care. - 1. ed., current. - Brasília-: Ministry of Health, 2018.

#### Comments:

*a - Doctors, nurses, nursing technicians and assistants, pathologists and pathology technicians, dentists, speech therapists, physiotherapists, support staff, maintenance and cleaning of hospital environments, stretcher bearers, ambulance drivers, X-ray technicians, and other professionals working in or frequently attending health services, such as representatives of the pharmaceutical industry and others*

*b - Residents of or travelers to areas with vaccination recommendation (all states in the North and Midwest regions; Minas Gerais, Espírito Santo and Maranhão; some municipalities in the states of Piauí, Bahia, São Paulo, Rio de Janeiro, Paraná, Santa Catarina and Rio Grande do Sul); the states of Sergipe (municipality of Canidé de São Francisco) and Alagoas (municipality of Delmiro Gouveia). Travelers to these areas should be vaccinated at least ten days before the trip.*

## 4 RESPIRATORY TRANSMITTED DISEASES

The respiratory tract is constantly susceptible to the transmission of pathogens, due to the exposed character of the superficial mucous membranes of the upper airways. Thus, the respiratory tract is one of the main forms of infection and dissemination of diseases, being

subdivided according to the form of dispersion in the air into droplets and aerosols. Droplets are particles larger than 5  $\mu\text{m}$  generated when coughing, sneezing or talking or during procedures such as aspiration, endotracheal intubation, cough induction by respiratory physiotherapy and cardiopulmonary resuscitation. Transmission occurs when a person is in close contact (in the range of one meter) with an infected person (PAHO, 2020). Droplet-borne diseases include: mumps, pertussis, diphtheria, meningococcal disease, erythema infectiosum, influenza, rubella, and COVID-19.

Aerosols are droplet nuclei, smaller than 5  $\mu\text{m}$ , that remain infectious when suspended in air for long distances and time, and can be inhaled by susceptible individuals, even in the absence of close contact with the ill person, especially in closed and poorly ventilated environments. Aerosol dissemination occurs in measles, tuberculosis (pulmonary or laryngeal), chickenpox, and COVID-19 (PAHO, 2020).

#### 4.1 DROPLETS

##### 4.1.1 Pre-Exposure Care

Individuals infected with droplet-borne pathogens should be kept in a private room, the door to which should be kept closed. The room can be shared between carriers of the same microorganism. Patient movement within the health care facility should be discouraged, and should occur only if absolutely necessary, with the patient wearing a surgical mask. In cases of patient transport, it is necessary to communicate the diagnosis to the area to which the patient will be taken. The circulation of other people in the private room (health professionals and family members) should always be done wearing a surgical mask, which should be placed before entering the environment and discarded in appropriate trash after leaving (CDC, 2007).

##### 4.1.2 Post-Exposure Care

We must incorporate infectious agent prevention measures into everyday life as a goal in the organization of occupational health and patient care programs. In addition, use droplet precautions as recommended for patients with suspected or known droplet-borne illnesses, which are generated by people coughing, runny nose, or talking. In case of accidental exposure of the employee during care, the Hospital infection control committee should evaluate each case, together with the physician on duty, guiding the indications and dispensing chemoprophylaxis.



Table 3 - Post-exposure measures for droplet-transmitted diseases

Disease	Etiology	Average Incubation Time	Transmissibility Period	Post-exposure prevention	Comments
Infectious Parotitis (Mumps)	<i>Paramyxovirus</i>	16-18 days (can vary from 12-25 days).	From 7 days before the first manifestations until 9 days after the onset of the clinical picture (BRASIL, 2019)	No	In hospital environments, respiratory isolation of patients should be adopted, as well as the use of personal protective equipment (PPE) (BRASIL, 2019)
Pertussis	<i>Bordetella pertussis</i>	5-10 days. (can vary from 4 to 21 days, but there are reports of up to 42 days)	From the 5th day after exposure until after 3 weeks of the onset of paroxysmal crises. In infants, it can extend up to 4 to 6 weeks (BRASIL, 2019)	<b>Azithromycin (1st option)</b> <6 months 10 mg/kg in one dose per day for 5 days It is preferred for this age group ≥6 months 10 mg/kg (maximum 500 mg) in one dose on day 1 and 5 mg/kg (maximum 250 mg) in one dose a day from day 2 to day 5 Adults 500 mg in one dose on day 1 and 250 mg in one dose a day from day 2 to day 5 <b>Sulfamethoxazole-Trimethoprim (SMZ-TMP), in case of macrolide intolerance</b> <2 months contraindicated Every 12 hours for 7 days: ≥6 weeks - 5 months SMZ 100 mg and TMP 20 mg ≥6 months - 5 years SMZ 200 mg and TMP 40 mg 6 to 12 years old SMZ 400 mg and TMP 80 mg Adults SMZ800 mg and TMP 160 mg (BRASIL, 2019)	--
Diphtheria <sup>a</sup>	<i>Corynebacterium diphtheriae</i>	1-6 days (may be longer).	On average, up to two weeks after the onset of symptoms. Appropriate antibiotic therapy eliminates, on most cases, the diphtheric bacillus from the oropharynx, 24 to 48 hours after	Erythromycin: <b>Children</b> - 40 to 50 mg/kg/day divided into 4 equal doses, for 7 days, orally; <b>Adults</b> -500 mg, every 6 h, for 7 days, orally (BRASIL, 2019)	Antidiphtheric serum is a very effective measure in the treatment of diphtheria (BRASIL, 2019)

			its introduction (BRAZIL, 2019 ).		
Meningococcal Disease	<i>Neisseria meningitidis</i>	3-4 days (can vary from 2 to 10 days.) <sup>b</sup>	It persists as long as <i>N. meningitidis</i> remains in the nasopharynx of the individual. 24 h of antibiotic therapy can eliminate	Rifampicin (600mg, 12/12h, 2 days), ceftriaxone (250mg, IM, single dose) or ciprofloxacin (500mg, VO, single dose) (BRASIL, 2019)	The use of corticoids in shock state is debatable due to uncertain influence on improving prognosis (BRASIL, 2019)
Erythema Infectiosum	Parvovirus B19 <sup>a</sup>	4-14 days	It reduces gradually after the onset of the exanthema <sup>d</sup>	No	-
Influenza	<i>Influenza Virus</i>	1-4 days	24 to 48 hours before the onset of infection there is transmission, but at lower levels than in the symptomatic period, between 24 and 72 hours of infection is the peak of transmissibility and declines by the 5th. Immunosuppressed people can excrete the virus for weeks or months. Children, compared to adults, also excrete the virus earlier, with a higher load viral and for long periods (BRASIL, 2019)	Oseltamivir phosphate, for 10 days. <b>Adults and children weighing more than 40kg - 75mg/day.</b> <b>Children weighing 23 to 40kg- 60mg/day.</b> <b>Children weighing 15 to 23kg- 45mg/day</b> <b>Children weighing less than 15kg- 30mg/day</b> <b>Children 9 to 11 months old- 3.5mg/kg</b> <b>Children 0-8 months old- 3mg/kg (BRASIL, 2109)</b>	It is indicated for people at high risk of complications, unvaccinated or vaccinated less than two weeks ago, after exposure to a suspected or confirmed case of influenza (BRASIL, 2019)
Rubella	<i>Rubivirus</i>	17 days. (12-23 day range)	Five to 7 days before onset of <i>rash</i> , up to 7 days after onset of <i>rash</i> (BRAZIL, 2019)	No	Susceptible pregnant women and children under 6 months of age should be kept away with suspected and confirmed cases and their contacts, during the period of transmissibility and incubation of the disease (BRAZIL, 2019) <sup>e</sup>

Source: BRAZIL. Ministry of Health (2019).

**Comments:**

- a. Transmission can also occur by contact.
- b. The patient stops transmitting the pathogen after 24 hours of adequate antibiotic therapy.
- c. The possibility of viral transmission occurring by aerosols (i.e., airborne) is described.
- d. Immunosuppressed patients can eliminate parvovirus for a prolonged period.
- e. Pregnancy should be avoided within three months of vaccination for rubella.

## 4.2 AEROSOLS

### 4.2.1 Pre-Exposure Care

Precautions for patients with aerosol-transmissible diseases are mainly related to air monitoring and control, the use of specially designed ventilation systems, the practice of antiseptic techniques, the use of personal protective equipment (PPE), and the execution of basic infection prevention measures (ATHER, B et al, 2020). Actions are divided into administrative, engineering, and individual spheres.

### 4.2.2 Administrative Measures

Administrative measures are the most effective in biosafety; they refer to the practices related to the reception of the patient suspected or diagnosed with aerosol-borne disease (BAHIA, 2001). Health units must be prepared to receive individuals who may be infected by aerosol-borne diseases, using administrative measures. These measures include: screening; identification; a single flow of people within the care setting; investigation routines, follow-up, and isolation, when necessary. These measures reduce the chances of disease transmission to patients and health professionals (BAHIA, 2001). In outpatient units, the existing literature on biosafety is scarce, although these places are the gateway to the health system (ARAÚJO, 2016).

In cases where the diagnosis has been previously established, it is possible to establish a specific shift to care for a group carrying the same disease, as is usually done in tuberculosis care. Each of these steps is responsible for reducing the exposure time of patients and healthcare workers to infectious particles.

### 4.2.3 Engineering Measures

The ventilation conditions of all areas considered at risk - that is, those where there is circulation of individuals with suspected or confirmed diagnosis of aerosol-borne disease infection - should be evaluated by a trained professional. The risk is considered high in (1) poorly ventilated rooms, (2) outpatient clinics and waiting rooms for patients with aerosol-transmitted diseases, (3) rooms for respiratory precautions, (4) bronchoscopy and induced sputum examination rooms, (5) necropsy rooms, (6) bacteriology laboratories, (7) emergency rooms, and (8) radiology and diagnostic imaging sectors. A specific room is required for patient accommodation, equipped with an air ventilation system with negative pressure in relation to adjacent areas and air filtration with HEPA (*high efficiency particulate air*) filters with six to twelve air changes per hour (CDC, 2007). The air in this room is considered contaminated in

relation to other rooms, so it should not reach the corridor; the air intake is done through a diffuser located at the entrance; doors and windows should be kept closed and well; sealed. The use of ceiling fans is not indicated (CDC, 2007).

In outpatient rooms for patients with tuberculosis, measles, and active varicella-zoster virus infections, there should be fan-induced air circulation between the patient and the professional, with the device positioned at table height and directed toward a window or door. (OPPERMANN et al., 2003). In cases of outpatient care, offices and waiting rooms, if any, should be large, open and airy environments, and the architectural design for health services should preferably meet these requirements (ARAUJO, 2016).

#### **4.2.4 Individual Protection Measures**

The use of respirator type mask (N95 or PFF2) with 95% filtration efficiency of particles with 0.3 $\mu$  diameter is mandatory. The mask should be put on before entering the room, checking its correct fit to the face and its sealing capacity. Removal should be done carefully after closing the door, be it outside the room, in the corridor or antechamber. The mask is for individual use, should be packed in a paper bag, with identification (name of the professional and date of first use in case of reuse). If the N95 masks are intact after use and are not wet, damp, or folded, their effectiveness is preserved for weeks or even months. In the management of patients with measles and varicella by individuals immune to these diseases, the use of masks is not mandatory (CDC, 2021).

Surgical masks should be offered to all users of the health system that circulate in environments with other users or health professionals, guiding the proper use. Although they do not provide protection to those who use them, these masks reduce the dispersion of particles produced by breathing, coughing, or sneezing. Finally, it is important to guide the patient to correct cough etiquette - cover the mouth and nose when coughing or sneezing, using tissue, discard it and then throw it in the trash (BRAZIL, 2020).

#### 4.2.5 Post-Exposure Care

Table 4 - Post-exposure measures for aerosol-transmitted diseases

Disease	Etiology	Average Incubation Time	Transmissibility Period	Post-exposure prevention	Comments
<b>VIRAL DISEASES</b>					
Measles	Morbillivirus	It can vary between 7 and 21 days	Six days before until 4 days after the onset of the rash. (BRAZIL, 2019)	Measles vaccine (live attenuated virus) within 72 hours after exposure <sup>b</sup> Measles Immunoglobulin, 0.25mL/kg (maximum 15mL), up to 144h after exposure.	The immunosuppressed should undergo evaluation before being vaccinated (BRAZIL, 2019) <sup>c</sup> Immunoglobulin should be used in this case.
Varicella and disseminated herpes zoster <sup>a</sup>	Human herpes virus type 3 <sup>d</sup>	Can vary from 10-21 days	Transmission occurs from two days before the onset of the rash until the time when all lesions are at the crusted stage. (BRAZIL, 2019)	Varicella vaccine 120 hours after exposure <sup>e</sup> . Anti-varicella-zoster immunoglobulin (VZIG), 125U/10kg (maximum 625U) up to 96h after exposure.	Prophylaxis with acyclovir <sup>f</sup> until the second week after exposure is an alternative (Asano et al., 1993), (Kumagai et al., 1999), (Lin et al., 1997).
<b>BACTERIAL DISEASES</b>					
Lung or laryngeal tuberculosis (confirmed or suspected)	<i>Mycobacterium tuberculosis</i>	Two to 12 weeks (for turning over the tuberculin skin test). Illness can occur at any time of life	Several months or weeks, depending mainly on whether the patient is bacilliferous.	Isoniazid 10mg/kg/day (maximum 300mg/day), for six months. (BRAZIL, 2019)	Chemoprophylaxis is indicated in those exposed with a reversal of the tuberculin skin test.

Source. Ministry of Health (2019).

**Comments:**

- a. Transmission can also occur by contact.
- b. Patients who have received immunoglobulin less than three months ago should not be vaccinated.
- c. Consider primarily immunosuppressed patients with lymphomas, leukemias, active untreated tuberculosis, AIDS, third-degree malnutrition, and those on immunosuppressants and/or corticosteroids.
- d. Other names include Varicella virus or varicella-zoster virus.
- e. Contraindicated in immunosuppressed patients and pregnant women; in these cases VZIG should be used.
- f. The published series are too small in terms of casuistry to make valid comparisons, but there is undoubtedly a possible indication for acyclovir administered between 7 and 14 days after exposure in vulnerable patients who have missed the optimal time for VZIG administration (Hambleton & Gershon, 2005).

### 5 DISEASES TRANSMITTED BY BIOLOGICAL FLUIDS

Occupational exposures to potentially contaminated biological materials are constant challenges in health care practice. Accidents involving blood and other organic fluids - such as semen, vaginal secretion, cerebrospinal fluid, synovial fluid, pleural, peritoneal, pericardial and amniotic fluid - correspond to the most frequently reported exposures (BRASIL, 2006).

Needle and sharp material related injuries, in general, are considered extremely dangerous because they are potentially capable of transmitting more than 20 different types of pathogens. The risk of transmission after accidents with biological fluids is variable and depends on the type of accident (percutaneous, lumen or non-lumen needle stick) and other factors such as severity, lesion size, presence and volume of organic fluid involved, in addition to the clinical conditions of the source patient and the correct use of post-exposure prophylaxis (CARDO et al., 1997). Among the several pathogens that can be transmitted by biological materials, the most important nowadays are the human immunodeficiency virus (HIV), hepatitis B (HBV) and C (HCV) and the protozoan *Trypanosoma cruzi*.

### 5.1 PRE-EXPOSURE CARE

In general, following the precautions - standard and based on the transmission route are basic and effective measures to prevent the transmission of pathogens by biological fluids, regardless of the defined or presumed diagnosis of infectious disease (BRASIL, 2010). The routine use of personal protective equipment, such as gloves, gowns, goggles or face shields, is recommended, especially when mucous-skin contact with blood or other biological materials can be anticipated.

Also included are the necessary precautions when handling needles or other sharp materials to prevent percutaneous exposure; and the necessary disinfection and sterilization when reusing instruments used in invasive procedures. Among the specific recommendations that should be followed when performing procedures involving the handling of sharps are: (1) Perform procedures with extreme care and attention; (2) Do not recap, bend, break, or remove needles from syringes; (3) Never use fingers as a shield while performing procedures involving sharps materials; (4) Properly dispose of all sharps (needles, scalpel blades, glassware, among others) after the procedure in an appropriate place; (5) The specific containers for disposal of sharps should not be filled above the limit of 2/3 of its total capacity and should always be placed near the place where the procedure is performed (BRASIL, 2010).

### 5.2 POST-EXPOSURE CARE

Accidental exposure to blood or other potentially infected body fluids is a medical emergency. The following steps should be taken immediately.

**Initial approach.** The first care after exposure can be performed by the victim themselves, who should be trained to deal with the situation. The post-exposure approach varies according to the type of accident. In cases of percutaneous accidents, it is recommended to wash

the affected area thoroughly with soap and water, without squeezing or rubbing the lesion. Antiseptic degerming solutions can also be used. In accidents involving mucous membranes, the wound should be washed only with running water and 0.9% saline solution. Alcohol-based solutions or solutions with other irritating components should be avoided. Incisions, local injections or any other procedure that can expand the lesion are contraindicated (BRASIL, 2012a).

**Report the accident to the health service and create a notification.** Accidents involving biological fluids should be promptly reported to the health service and other professionals. The event must be notified in the Information System of Notifiable Diseases (SINAN) through the form of investigation of occupational accidents with exposure to biological material. In these cases, it will be necessary to establish procedures for analysis of similar accidents that occurred in the unit, according to guidelines of the SUS Worker Health Promotion Policy (BRASIL, 2012a).

**Evaluate the circumstances of the accident.** Faced with the accident, it is necessary to first identify if the professional was using PPE, the injured person's vaccination status (complete, incomplete or not performed), if there is previous immunity to hepatitis B and if the individual was previously diagnosed with any infectious disease. In addition, it is recommended to identify if the accident involved sharp objects, if there was contact with mucous membranes, and if the victim's skin is intact. As soon as this approach is taken, serology for HIV, HBV, HCV and other pathogens involved in the accident should be performed (BRASIL, 2004).

**Evaluate the source of infection.** It is necessary to investigate the serological status and the presence or absence of infectious diseases in the source individual of the biological material to which the healthcare professional was exposed. The patient should be instructed about the need for blood collection for rapid tests for HIV, hepatitis B and hepatitis C, which will only be performed with the authorization of the patient or his/her legal guardian. In case of accident involving biological material of unknown origin (inadequate disposal, for example), the probability of risk of infection should be assessed and decide, case by case, at the medical discretion responsible for the case, whether or not prophylaxis is indicated (BRASIL, 2015).

**Welcoming and orientation.** Reception is a fundamental part of the care provided to the exposed individual. Ideally, a safe and private space should be provided for orientation and care, in addition to psychological support. One must also identify possible risk attitudes, behavioral patterns or psychological conditions that influenced the accident, to develop plans and thus increase the protection of the person, inquiring about the excessive workload, availability and use of PPE and sharp instruments with safety devices (BRASIL, 2010).

## 6 INFECTION BY SPECIFIC PATHOGENS

### 6.1 HUMAN IMMUNODEFICIENCY - HIV

The estimated risk of HIV infection is influenced by several factors, such as type of exposure, affected area and biological fluid involved in the accident. The average risk of transmission in percutaneous accidents is 0.3% and 0.09% in accidents involving the mucosa. The risk after exposures involving non-intact skin is not precisely quantified, but it is estimated to be lower than the risk of mucosal exposures (IPPOLITO et al., 1993). As for biological material, blood (or any fluid that contains it), semen, vaginal secretion, tissues and cultures are considered fluids with higher risks of transmission. Fluid, serous fluids (pleural, pericardial, peritoneal), amniotic fluid and joint fluid are part of a group of potentially infectious materials. Tears, sweat, feces, urine and saliva (except in dental settings) are considered to be biological materials without risk of transmission. Human bites should be considered a risk if they involve blood. Other factors are also related to a higher probability of HIV transmission, such as deep injury, visible blood in the material, procedures involving material directly introduced into the source patient's vein or artery, accidents with large-caliber needles that presuppose a higher volume of blood and exposures involving patients with terminal acquired immune deficiency syndrome (AIDS) - due to a likely high viral load or the presence of other factors such as syncytium-inducing viral strains (CARDO, 1997). It is important to emphasize that HIV transmission is still possible even in patients whose viral load is low (1,500 copies/mL, for example) or undetectable. The plasma viral load only reflects the amount of free viral particles present in the peripheral blood; cells with latent infection can transmit HIV in the absence of viremia (KUHAR et al., 2013).

Cases of occupational contamination by HIV can be characterized as proven or probable. In general, proven cases of contamination by occupational accident are defined as those in which there is documented evidence of serum conversion and its temporal demonstration associated with exposure to the virus. At the time of the accident, the professionals have non-reactive serology, and during follow-up, reactive serology is evidenced. Some cases in which exposure is inferred (but not documented) can also be considered as proven cases of contamination when there is evidence of homology of the sequential analysis of the viral DNA of the source patient and the healthcare worker. Nevertheless, exposure to the virus is considered a medical emergency and requires an adequate and agile prophylaxis scheme. The preferential post-exposure regimen should be initiated within the first hour, with two hour tolerance. After 72 hours of the accident, chemoprophylaxis is not indicated due to its



lack of efficacy (TSAI et al., 1995, TSAI et al., 1998). The ideal duration of chemoprophylaxis is not yet known (KUHAR et al., 2013), the standard scheme of 28 days being used.

In Brazil, the three types of HIV post-exposure antiretroviral prophylaxis (PEP) - occupational accident, sexual violence and consensual sexual intercourse - have been unified into a single preferential scheme, which associates tenofovir (TDF), lamivudine (3TC) and dolutegravir (DTG) for 28 days (**Table 5**). It is a potent, tolerable method with low interaction with other drugs (BRASIL, 2017). However, knowledge about the effectiveness of PEP is still limited, as it encompasses both the lack of more precise data on the relative risk of different types of exposure and the risk of toxicity of antiretroviral drugs (BRASIL, 2015).

In case of inability to test the source-patient, whatever the reasons, or exposure to the source person previously exposed to several antiretroviral regimens or in virological failure (viral load detectable after six months of antiretroviral initiation or exchange, which is indicative of a resistant viral strain), the preferential regimen should be initiated within the first 120 minutes after the accident and a reevaluation of the case by a specialist should be urgently requested for PEP adequacy, preferably based on recent genotyping results (last 12 months) of the source patient (BRASIL, 2017).

Serological follow-up of the injured professional is indicated, regardless of the use of chemoprophylaxis. An HIV antibody test (ELISA) should be requested at the time of the accident, 30 days and three months after exposure, even after completion of antiretroviral prophylaxis (ARVs), as well as evaluation of ARV toxicity (usually two weeks after introduction of antiretrovirals) (BRASIL, 2017).

In special situations, serological evaluation should be repeated after 12 months, highlighting events involving (1) source patients co-infected by HIV/HCV, in which contamination of the injured professional by HCV has occurred (KUHAR et al., 2013) and (2) exposure to the source co-infected by HIV/HCV, but without contamination of the injured person by HCV, in addition to (3) the injured professional whose history suggests inability to produce antibodies (BRASIL, 2017).

Chart 5 - HIV post-exposure prophylaxis (PEP) regimens - Brazil

<b>Antiretroviral prophylaxis after exposure to HIV</b>	
<b>Preferred scheme (28-day duration)</b>	TDF (300mg)/3TC (300 mg) - 1 cp VO/1x day + DTG (50mg) - 1 cp VO/1x day
<b>Alternative regimen if TDF contraindicated (28-day duration)</b>	AZT (300 mg)/3TC (150mg) - 1 cp VO 2x/day + DTG (50mg) - 1 cp VO/1x/day
<b>Alternative regimen if DTG contraindicated (28-day duration)</b>	TDF (300mg)/3TC (300 mg) - 1 cp VO/1xday + ATV (300mg) - 1 cp VO/1xday + RTV (100mg) - 1 cp VO/1xday
<b>Alternative regimen if VCT is contraindicated (28-day duration)</b>	TDF (300mg)/3TC (300 mg) - 1 cp VO/1xday + DRV (600mg) - 1 cp VO 2x/day + RTV (100mg) - 1 cp VO 2x/day

**Source:** BRAZIL. Ministry of Health. Health Surveillance Secretariat. Department of STD, AIDS, and Viral Hepatitis. Clinical protocol and therapeutic guidelines for post-exposure prophylaxis (PEP) of risk for HIS, STI, and viral hepatitis infection. Brasília: Ministry of Health, 2018.

**Acronyms:** Tenofovir (TDF), Lamivudine (3TC), Dolutegravir (DTG), Zidovudine (AZT), Atazanavir (ATV), Darunavir (DRV), Ritonavir (RTV), tablet (cp), orally (VO).

## 6.2 HEPATITIS B VIRUS (HBV)

The risk of contamination by the Hepatitis B virus (HBV) is related mainly to the degree of exposure to blood in the workplace and also to the presence or absence of HBeAg antigen in the source patient. In percutaneous exposures involving blood known to be infected with HBV and with the presence of HBeAg (reflecting a high rate of viral replication and therefore a higher amount of circulating virus), the risk of clinical hepatitis ranges from 22 to 31% and that of serologic evidence of infection from 37 to 62%. When the source patient has only the presence of HBsAg (HBeAg negative), the risk of clinical hepatitis ranges from 1 to 6% and that of serological conversion 23 to 37% (CDC, 2001). Post-exposure management of hepatitis B virus is variable and depends on the serologic status of the exposed health care worker and the source patient (**Table 6**). The prophylaxis regimen - by vaccine, immunoglobulin, or both - should be performed preferably in the first 24 hours after the accident, not exceeding seven days. The effectiveness of post-exposure prophylaxis is highest when immunoglobulin is used within the first 24 to 48 hours after the accident. Professionals who have experienced HBV infection are immune to reinfection and do not require post-exposure prophylaxis. In scenarios where there is no proof of immunity to hepatitis B of the injured person and in unvaccinated professionals, it is recommended clinical and laboratory follow-up of the professional for six months after exposure, requesting, at the end of this period, viral markers of hepatitis B for investigation: HBsAg, anti-HBs and anti-HBc (BRASIL, 2010).

Table 6 - Prophylaxis after occupational exposure to the hepatitis B virus

Exposed Health Care Professional	Source patient		
	HBsAg reagent	HBsAg not reagent	Unknown or untested HBsAg <sup>1</sup>
Not vaccinated	<b>IGHAB</b> + start vaccination	Start vaccination	Start vaccination*
Incompletely vaccinated	<b>IGHAB</b> + complete vaccination	Complete vaccination	Complete vaccination
Previously vaccinated with known and adequate vaccine response ( $\geq 10\text{mUI/mL}$ )	No specific measures.	No specific measures.	No specific measures.
No vaccine response after the 1st series (3 doses)	IGHAHB + first dose of vaccine Hepatitis B OR IGHAB two doses, 30 days apart**	Start new vaccination series (3 doses)	Start new vaccination series (3 doses)*
No vaccine response after the 2nd vaccine series	<b>IGHAB</b> two doses, 30 days apart**	No specific measures	<b>IGHAB</b> two doses, 30 days apart**
Unknown vaccine response to test → the health care provider	If adequate vaccine response: no specific measures	If adequate vaccine response: no specific measures	If adequate vaccine response: no specific measures
	If inadequate vaccine response: IGHAB + first dose of vaccine hepatitis B	If vaccine response is inadequate: do a 2nd round of vaccination	If vaccine response is inadequate: do a 2nd round of vaccination*

**Sources:**

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**Comments:**

- \* The associated use of anti-hepatitis B immunoglobulin is indicated if the source patient is at high risk of HBV infection, such as illicit injecting drug users, patients on dialysis programs, household and sexual contacts of HBsAg carriers, people who have sex with people of the same sex, heterosexuals with multiple partners and unprotected sex, previous history of sexually transmitted diseases, patients from geographic areas with high endemicity for hepatitis B, people from prisons and institutions for mentally disabled patients.
- \*\* Two-dose IGHAB should be given one month apart. This option should be indicated for those who have had two sets of three doses of the vaccine but have not had an adequate response or have severe allergy to the vaccine.
- <sup>1</sup> It is recommended to use rapid HBsAg tests (result released in less than 30 minutes), when rapid release of conventional serology (ELISA) results is not possible, in order to avoid unnecessary administration of HBIG.

### 6.3 HEPATITIS C VIRUS (HCV)

The average incidence of serum conversion after percutaneous exposure with blood known to be infected with HCV is 1.8% (ranging from 0 to 7%), varying according to the type of exposure and the viral load of the source patient (BRASIL, 2010). Transmission of HCV from mucosal exposure is extremely rare. Initially, the management of an accidental event with biological material from an anti-HCV positive source is expectant, with follow-up of the

exposed professional, as shown in **Chart 7**. If the injured person presents (1) recent seroconversion (less than six months ago) and documented by means of anti-HCV conversion or (2) non-reactive anti-HCV and detection of CV-HCV within 90 days after the exposure date, it is considered a diagnosis of acute hepatitis C, and clinical-laboratorial follow-up of the individual should be performed (BRASIL, 2018).

After the diagnosis of acute hepatitis C is confirmed, treatment should be started immediately - on average, four weeks after exposure. The initial treatment regimen is preferably composed of alphapeginterferon, associated or not with ribavirin, regardless of genotype. In patients coinfecting with HIV, the addition of ribavirin is suggested (BRASIL, 2018).

Chart 7 - Follow-up of the exposed person when the source is HCV-reactive

Exam	1 <sup>o</sup> attendance	Follow-up of the exposed person when the source is reagent for hepatitis c		
		4-6 weeks after exposure	3 months after exposure	6 months after exposure
ALT	Yes	Yes	Yes	Yes
HCV-RNA (qualitative)	No	Yes	Yes	No
Anti-HCV	Yes <sup>(a)</sup>	Yes	Yes	Yes

Source: DIAHV/SVS/MS (BRASIL, 2018)

<sup>(a)</sup>Anti-HCV reagent on first visit: a person who was previously exposed, so had contact with HCV before the exposure that motivated the visit.

## 6.4 FURTHER RECOMMENDATIONS

In accidents that occur in a hospital environment, after post-exposure care, it is necessary to notify the event to the Hospital Infection Control Committee and provide guidance to exposed professionals. Among the recommendations, the following are: use of condoms during sexual intercourse; no donation of organs or biological fluids (blood, semen, tissues); no sharing of syringes and needles; need for contraception (in order to prevent a possible transmission of infection to the child in case of pregnancy); and interruption of breastfeeding, if breastfeeding (BRASIL, 2017).

## 6.5 SPECIAL SITUATIONS

### 6.5.1 Severe Acute Respiratory Syndrome (SARS)

The first cases of SARS (SARS - "*Severe Acute Respiratory Syndrome*") associated with the coronavirus (SARS-CoV or SARS CoV-1) were reported in China in The 2002.SARS-CoV spread rapidly to over a dozen countries in North America, South America, Europe, and Asia, infecting more people 8.000 and causing around deaths, 800 before the global SARS epidemic

was brought under control in 2003. Since then, no 2004, cases of SARS have been reported worldwide. Like most pathogens that cause viral respiratory infections, SARS-CoV is transmitted by droplets, although transmission through inhalation of residual airborne particles (aerosols) - and other routes not yet known - is not ruled out. Thus, it is suggested that patients with clinical features consistent with SARS should be hospitalized and kept under a precautionary regimen for droplet, aerosol, and contact transmission (**Chart 8**) (BRASIL, 2010).

Table 8. Contact Precaution Patient Management

<b>Clarifications<sup>a</sup></b>	The patient and his or her caregiver, family member, or legal guardian must be aware of the reasons why contact precaution is necessary.
<b>Hospitalization</b>	Hospitalization should preferably take place in a private room. If this is not possible, the distance between beds should be one meter.
<b>Signaling</b>	Fix a sign on the door of the room or at the bedside indicating that the patient is under contact precaution.
<b>Costume</b>	Wear a long-sleeved, preferably disposable, gown. If this is not possible, individualize the patient care gown.
<b>Equipment</b>	Thermometers, sphygmomanometers, and stethoscopes should be for the patient's exclusive use and kept at the bedside or in the private room.
<b>Procedures</b>	Wash hands beforehand and wear procedure gloves and gown during all patient care. These should be put on immediately before contact with the patient or surfaces near the patient and removed immediately after use. Hands should be sanitized afterwards.

**Source:** BRAZIL. Ministry of Health. Agência Nacional de Vigilância Sanitária. Interventions and Measures for Prevention and Control of Microbial Resistance. Brasília/DF, 2010. Table adapted from material available at [http://www.anvisa.gov.br/servicos/controle/precaucoes\\_a3.pdf](http://www.anvisa.gov.br/servicos/controle/precaucoes_a3.pdf).

**Observation:**

a. Major conditions requiring contact precaution include (A) colonization and/or infection by multidrug-resistant bacteria, (B) *Clostridium difficile* gastroenteritis, (C) gastroenteritis in persons in diaper use or with fecal incontinence caused by *Escherichia coli*, *Campylobacter* spp, *Shigella* spp, hepatitis A, hepatitis E, rotavirus, norovirus, adenovirus, (D) respiratory syncytial virus, (E) parainfluenza virus, (F) varicella-zoster virus, (G) diphtheria, (H) skin infections (impetigo, pediculosis, scabies), (I) mucocutaneous, disseminated or severe primary herpes simplex, (J) viral and/or hemorrhagic conjunctivitis, (L) viral hemorrhagic syndromes (Ebola, Lassa or Marburg), (M) enterovirus (meningitis) in children and neonates, (N) infections caused by *Streptococcus pyogenes* and *Staphylococcus aureus* with drainage of secretion not contained by the dressing or in the absence of dressings (Siegel et al., 2007). Contact isolation can also be used to control institutional outbreaks caused by the aforementioned pathogens (Siegel et al., 2007).

6.6 MERS

In April 2012, a new coronavirus, distinct from the one that caused SARS-CoV, was isolated. The pathogen was unknown as a human disease agent until its identification, initially in Saudi Arabia and subsequently in other Middle Eastern countries, Europe, and Africa. All cases identified outside the Arabian Peninsula had a history of travel or recent contact with

travelers from Middle Eastern countries - Saudi Arabia, Qatar, United Arab Emirates, and Jordan. Due to the location of the cases, the disease was designated as Middle East Respiratory Syndrome and spread worldwide through the acronym MERS (*Middle East Respiratory Syndrome*), and the new virus was named MERS-associated coronavirus (MERS-CoV) (ALMEIDA et al., 2020).

## 6.7 COVID -19

In December 2019, hundreds of similar cases of acute respiratory tract infection by unknown agent were reported in Wuhan, China. The pathogen was later identified as a novel coronavirus (SAR CoV-2). The disease spread rapidly across the country and within days reached 85 countries (GUO, Y.R et al, 2020), and on March 11, 2020 the World Health Organization (WHO) declared a pandemic. The emergence of SARS-CoV-2, since the severe acute respiratory syndrome coronavirus (SARS-CoV) in 2002 and the Middle East respiratory syndrome coronavirus (MERS-CoV) in 2012, marked the third introduction of a highly pathogenic, large-scale coronavirus epidemic into the human population in the 21st century. Studies have estimated the replication rate of SARS-CoV-2 at about 2.2 or even higher (range 1.4 to 6.5) (PRATEEK BAHL et al, 2020). Initially, internationally established prevention measures included contact and droplet precautions. However, later studies pointed out that SARS-CoV-2 can be transmitted over long distances, simulating aerosol transmission, due to its ability to adsorb to dust particles (MOHAN et al, 2021). The virus was found at a distance of 4 meters from an infected patient and suspended in the air for up to 3h after the patient left the room. Thus, it is suggested that for the management of patients with clinically compatible with SARS CoV-2 infection, they should be hospitalized and kept on a precautionary scheme for droplet transmission, aerosol and contact precaution (SANTOS et al, 2020).

## 6.8 CONCLUDING REMARKS

The protocols and norms in biosafety are for actions of prevention and confrontation of infectious diseases and must be strictly followed by all professionals who deal directly with the risk of transmission. However, the construction of care in biosafety is also a collective ethical-social commitment, of respect, trust, and local, national and global responsibility. For this, it is necessary to think of biosafety as public policy and commitment to ensure international security (SEGATA, 2020; ZHOU et al, 2019). It is necessary to expand monitoring in biosafety, through cooperation between countries in risk analysis, resources for prevention and control of

infectious diseases, also acting in oversight and management in biotechnology and genetic engineering (ZHOU et al, 2019).

In addition, it is necessary to promote the creation and maintenance of safety committees, such as the Internal Commission for Accident Prevention (CIPA), Specialized Services in Safety Engineering and Occupational Medicine (SESMT) and/or the Commission for Hospital Infection Control (CCIH), exercising the assigned functions correctly and responsibly for the protection of workers' health (BRAND, FONTANA, 2014).

At the individual level, it is necessary that the posture of the professional facing the risk is of constant attention, prudence and vigilance, making each measure a medullary habit rooted in routine. It is emphasized that experience and self-confidence do not exempt professionals from accidents and occupational aggravations arising from exposure to infectious agents, and therefore should never replace precautions and the use of PPE (BRAND, FONTANA, 2014). On the other hand, it is also understandable that, even when all reasonable precautions are taken, accidents can happen. Health professionals need to be prepared to deal with exposures, mastering the theoretical knowledge and prophylactic measures, but also being ready to receive individuals injured with biological material. It is known that occupational accidents can be linked to acute stress disorders, sleep deprivation, and other psychological issues, which are exacerbated after an exposure episode. Thus, it is necessary that all health professionals master and follow biosafety rules during their work activities, to avoid as much as possible accidental contamination. It is also fundamental that they have a clear idea of what should be done in these episodes, to institute the best possible prophylaxis and to welcome the injured person in his/her suffering.

**Did the research go through an ethics committee?** It was NOT necessary to go through the REC. It was not submitted to the CEP, since it is not research involving human beings.

### **Conflicts of interest**

The authors declare that there are no conflicts of interest.

### **Authors' contribution**

All the authors were involved in all the processes of the study and construction of the text.

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