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RETHINKING BIOLOGICAL HAZARD RISK ANALYSIS AFTER PANDEMIC COVID-19

REPENSANDO O PAPEL DE ANÁLISE DE RISCO DE PERIGO BIOLÓGICO APÓS COVID-19 DE PANDEMIA

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ABSTRACT
The paper underlines the importance of biological hazard risk assessment today especially analyzing the Covid-19 pandemic lack of good biological hazard management all over the world. We discuss biological hazard, types, classifications and analysis of the risks. We suggest some main tools and frameworks to be used to assess, monitoring, control and prevent biological hazards. As a result, we strength the importance of such methodology to be known by decision makers, improved, developed. The risk management method must be coordinated all over the country and the world to be successful. Everybody (people, firms, government organizations) is responsible for the success of the implementation plan and prevent risks. So, education and professional competence of risk management must be developed and certified by independent authority using general accepted standard protocols to complement a governance system of biological hazard risk analysis.

KEYWORDS: Risk management and analysis. Best practices. Biological Hazard. Covid-19Pandemic.

RESUMO
O artigo ressalta a importância da analise e avaliação do risco biológico hoje em dia especialmente devido a falta em encontrar boas praticas de gestão do risco na pandemia de Covid-19 em todo o mundo no artigo há uma discussão do risco biológico, tipos, classificação e analise de riscos. O artigo sugere ferramentas para avaliar,monitorar, controlar e prever riscos biológicos. Como resultado se ressalta a

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importância de tal metodologia para ser conhecida dos tomadores de decisão, melhorada e desenvolvida. O método de analise do risco deve ser coordenado em todo o país e em todo o mundo para ser bem sucedido. Todos (pessoas, empresas, governos) são responsáveis para o sucesso do plano de implementação e paras prever os riscos. Assim educação e competência profissional em relação a gestão do risco deve ser desenvolvida e certificada para uma autoridade independente usando padrões internacional aceitos e protocolos para complementar a governança do sistema de risco biológico.

PALAVRAS CHAVE: Análise do risco. Risco biológico. Pandemia Covid-19.

1. INTRODUCTION

The evidence of more than a year of pandemic outbreak is that erroneous overview and lack of plan made by government, firms and individuals had tremendous social and economic costs (Zielinski & Botero,2020).We argue that the best lesson we can have from pandemic outbreak is just that we must pay more attention on hazards, future outbreak but especially we must turnover our attitude about risk prevention, especially biological hazards (Duckett, 2020).

We all understand well, after de Covid-19 pandemic outbreak, the importance of preventive and risk management related to biological hazard, however government decisions are not always determinate by experts and scientific advisors, not all organization are following and planning best practice and risk management voluntary (Shaw; Kim & Hua, 2020). It is evident also that after months of crisis the democratic system and government response is late, slow, and willing dangerous impacts when lockdown only when the crisis paramount arises. Also, Lockdown is often criticized not only because of the implementation but also as a not democratic attitude of the government (Shaw; Kim & Hua, 2020).

Strategies to mitigate risks as: controls, selective quarantine, mandatory social distance, and others, are often random implemented or are neglected. Justifications are to save the health capacity of recovery (bed and intensive health systems) that is inadequate, related to pandemic best response, and was not improved before, or save employment.

There is also a lack of capacity in terms of personnel (number and rotation) and coordination of all scientific experts (university, foundations, international research teams). We saw that all over the world, to prevent, cure and foresee pandemic impacts made by whom we vote (and we must say we pay very well) to manage public services and emergency was, in our opinion, related to biological hazard, an awfully bad performance.

In this paper we try to figure some suggestions to rethink errors of our performance and some tools to improve our biological hazard management which must be included into a general risk analysis and management routine (Wolff, 2020). We must use new protocols suggested and experimented during the present crises, but what we try to figure out in this paper is an overall view of biological hazard framework (Shaw; Kim & Hua, 2020). We ought to suggest especially for organizations like firms, governmental offices, educational institutions, between others, to put the biological hazard as a priority in the priority of risk analysis.

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2. BIOHAZARDS

Global pandemics like COVID-19 are posing a serious threat especially consider their strong socio-economic impact all over the world (Amekudzi-Kennedy, A. et al 2020; Aveni, A. de Pinho Filho, L. C. 2020; Chokshi, D. A. & Katz, M. H. 2020; Ferreira Junior, R. R. & Santa Rita. L. P. 2020; Di Bari, C. (2020). Howarth, C. et al 2020; Millán, N. & Santander, G. 2020; Pestiaux, D. & Debongnie, JC 2020; Selvati, F. de S. et al. 2020).

Throughout the centuries, countries have experienced epidemics. Biological hazards are of organic origin or conveyed by biological vectors, including pathogenic microorganisms, toxins, and bioactive substances. A biohazard is a substance harmful to living organisms. A biological hazard, or biohazard, is also called a biological event that poses a threat to the health of living organisms, primarily humans.

Epidemics and pandemics are biological hazard from viruses or bacteria and are alike: contamination of raw materials before delivery, contamination of raw materials after delivery, pesticide, contamination with toxic chemical materials after usage of improper chemicals (disinfections and disinfections materials), metal contamination and wood of raw.

Some examples of recent large outbreaks, epidemics due to biological hazards are: Coronavirus (SARS-CoV-2), a pandemic started in 2003, H1N1 Swine Flu, Middle East Respiratory Syndrome – Coronavirus (MERS-CoV), an emerging disease identified in 2012, The Ebola Virus Disease outbreak in West Africa in 2013-2016, yellow fever in Angola, the Democratic Republic of Congo and Uganda in 2016, Zika virus infection in the Americas and the Pacific region in 2016

WHO[3] (2019) defines biological hazards as follow: “Biological hazards are of organic origin or conveyed by biological vectors, including pathogenic microorganisms, toxins and bioactive substances. Examples are bacteria, viruses, or parasites, as well as venomous wildlife and insects, poisonous plants and mosquitoes carrying disease-causing agents”.

The UNDRR / ISC (UN 2017) technical report on hazard definition has divided biological hazards into 95 specifics. Some clusters are: aquaculture (marine toxin, biotoxin), insect infestation (locust etc.), invasive species (weeds), human / animal conflict / interaction (snake envenomation), food safety (foodborne parasites), infectious diseases (plant, human and animal, aquaculture).

Again WHO (2109) also reclassified biological hazards because some have routine measures in place to address and manage them. That means that have hazards that are managed routinely. So many hazards are not usually considered as hazards but are classified for example as infectious diseases which can be treated with medication and do not post a high epidemic risk. Biological risk however include disease so the WHO reclassification could be understanding to divide biological hazard that could be easily detected and managed from severe risks and outbreaks that would develop global impacts.

[3] HEDRM (Health Emergency Disaster Risk Management Framework) 2019. Open-ended Intergovernmental Expert Working Group on Indicators and Terminology Relating to Disaster Risk Reduction and UNGA endorsement available at: https://www.preventionweb.net/drr-framework/open-endedworking-group/

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As example, these categories of biological hazards are originally derived from the International Health Regulation :
- Airborne diseases.
- Waterborne diseases.
- Vector-borne diseases.
- Foodborne outbreaks.
- Insect infestation (for example, grasshopper or locust).
- Animal diseases.
- Plant diseases.
- Aeroallergens.
- Antimicrobial resistant microorganisms.
- Animal-human contact.
- Venomous animals (for example, scorpions, snakes, spiders).

Biological hazard depends from a bunch of biohazardous agents. These are classified by UN number (US 2012) such as: Category A, UN 2814 – Infectious substance, affecting humans: An infectious substance in a form capable of causing permanent disability or life-threatening or fatal disease in otherwise healthy humans or animals when exposure to it occurs.

Category A, UN 2900 – Infectious substance, affecting animals (only): An infectious substance that is not in a form generally capable of causing permanent disability or life-threatening or fatal disease in otherwise healthy humans and animals when exposure to themselves occurs.

Category B, UN 3373 – Biological substance transported for diagnostic or investigative purposes. Regulated Medical Waste, UN 3291 – Waste or reusable material derived from medical treatment of an animal or human, or from biomedical research, which includes the production and testing. Another way to classify biological hazard is by level of biohazard. The United States Centers for Disease Control and Prevention (CDC) categorizes various diseases in levels of biohazard (reference):

Biohazard Level 1: Bacteria and viruses including *Bacillus subtilis*, canine hepatitis, *Escherichia coli*, and varicella (chickenpox), as well as some cell cultures and non-infectious bacteria. At this level precautions against the biohazardous materials in question are minimal, most likely involving gloves
and some sort of facial protection.

Biohazard Level 2: Bacteria and viruses that cause only mild disease to humans or are difficult to contract via aerosol in a lab setting, such as hepatitis A, B, and C, some influenza A strains, Human respiratory syncytial virus, Lyme disease, salmonella, mumps, measles, scrapie, dengue fever, and HIV. Routine diagnostic work with clinical specimens can be done safely at Biosafety Level 2, using Biosafety Level 2 practices and procedures. Research work (including cocultivation, virus replication studies, or manipulations involving concentrated virus) can be done in a BSL-2 (P2) facility, using BSL-3 practices and procedures.

Biohazard Level 3: Bacteria and viruses that can cause severe to fatal disease in humans, but for which vaccines or other treatments exist, such as anthrax, West Nile virus, Venezuelan equine encephalitis, SARS coronavirus, MERS coronavirus,

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SARS-CoV-2, Influenza A H5N1, hantaviruses, tuberculosis, typhus, Rift Valley fever, Rocky Mountain spotted fever, yellow fever, and malaria.

Biohazard Level 4: Viruses that cause severe to fatal disease in humans, and for which vaccines or other treatments are *not* available, such as Bolivian hemorrhagic fever, Marburg virus, Ebola virus, Lassa fever virus, Crimean–Congo hemorrhagic fever, and other hemorrhagic diseases, as well as Nipah virus. Variola virus (smallpox) is an agent that Is worked with at BSL-4 despite the existence of a vaccine, as it has been eradicated and thus the general population is no longer routinely vaccinated. When dealing with biological hazards at this level, the use of a positive pressure personnel suit with a segregated air supply is mandatory. The entrance and exit of a Level Four biolab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed, and Levels of biohazard are electronically secured to prevent doors from both opening at the same time. All air and water service going to and coming from a Biosafety Level 4 (P4) lab will undergo similar decontamination procedures to eliminate the possibility of an accidental release. Currently there are no bacteria classified at this level.

3. BIOHAZARD CONVENTIONS AND GOVERNANCE

The cost benefits analysis about biological hazard outbreak was so big, in social and economic impacts (mostly due to imposed lockdown) that worth the effort and the necessity to include into strategic plan to define mitigations and opportunities for the organization activities (Selvati et al, 2020). The challenge is to shift costs from mitigate and emergence (after the negative event) to prevention costs that are less, although are to be made today. We argue we must change the attitude of politicians, in CEO of great firms and in government, to postpone decisions such a biological risk not to impact the present performance to be shown to public today hoping shift for other moments or people the greater cost.

Then a governance of the risks using the classifications made the previous section is critical. For that, at international level were defined many protocols. Being pandemic a movement all over the world, and every outbreak of disease could be growth, in not contained, as a pandemic, it critical control internal and external movement of biohazards.

One is the Cartagena Protocol on Biosafety to the convention of biolgical diversity (UN 2015) that states in Art. 1 that In accordance with the precautionary approach contained in Principle 15 of the Rio Declaration on Environment and Development, the objective of Protocol is to contribute to ensuring an adequate level of protection in the field of the safe transfer, handling and use of living modified organisms resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity, taking also into account risks to human health, and specifically focusing on transboundary movements.

To govern a biological hazard system the Article 16 say, about risk management that, at first *all the parties* must establish and maintain appropriate mechanisms, measures and strategies to regulate, manage and control risks identified in the risk assessment provisions associated with the use, handling and

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transboundary movement of living modified organisms. Meaning that it´s a coordinate and simultaneous movement, exactly the opposite as we saw till today.

Second, that in case of high level biohazard all measures based on risk assessment shall be imposed to the extent necessary to prevent adverse effects of the living modified organism on the conservation and sustainable use of biological diversity, taking also into account risks to human health, within the territory of the Party of import. Each Party shall endeavor to ensure that any living modified organism, whether imported or locally developed, has undergone an appropriate period of observation that is commensurate with its life cycle or generation time before it is put to its intended use

Third, the article underline also that, each Party shall take appropriate measures to prevent unintentional transboundary movements of living modified organisms, including such measures as requiring a risk assessment to be carried out prior to the first release of a living modified organism.

Fourth, all parties shall cooperate to identifying living modified organisms or specific traits of living modified organisms taking appropriate measures regarding the treatment of such living modified organisms or specific traits.

An example of conventions of many countries and governance is The European Union Civil Protection Mechanism (UCPM), created in 2001 (EU 2001a). The UCPM promotes cooperation in the field of civil protection disaster response, preparedness, and prevention. UCPM focus on biological hazards including pandemic and emerging infectious diseases, their identification, their recognition of their direct and cascading impacts, cross-border dimensions, etc.

The UCPM coordinated agencies as the Union's Emergency Response Coordination Centre (ERCC), that focus on regional cooperation and solidarity across prevention, preparedness, and response priorities. The legal base of ERCC is the European Civil Protection Pool (ECPP) that defines dedicated prevention actions on risk assessments, disaster risk management planning, peer reviews, training programs, simulation exercises, and lessons learnt initiatives. Another coordinated mechanism for EU countries is the European Medical Corps. The rescEU reserve is providing additional capacities of medical evacuation, medical teams trained for setting up a field hospital, and common stockpiling of medicine.

In the pandemic today, added to Union Civil Protection Mechanism/rescue (EU 2001b), the EU has set up the Coronavirus Response Investment Initiative to deploy European Structural and Investment Funds. This is a response that partly address the current public health emergency mobilizing Emergency Support Instrument. Even if the mechanism didn´t work very well was the first case of a coordinated mechanism all over many countries in the world today.

An agency that must support the governance mechanism in Europe is the Disaster Risk Management Knowledge Centre (DRMKC) (EC 2016) that must provide a coherent interface between science and policy by contributing research on hazard modelling, forecasting and early warning systems, crisis management technology, critical infrastructure protection, risk standard setting and risk assessment methodologies.

Related to DRMKC the Copernicus Emergency Management Service provides timely geo-spatial information, such as satellite-based maps, for disaster preparedness, emergency response and recovery monitoring. The EU has developed

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an Action Plan on the Sendai Framework that use Bankok principles EC 2016) for Disaster Risk Reduction 2015-2030: A disaster risk-informed approach to all EU policies.

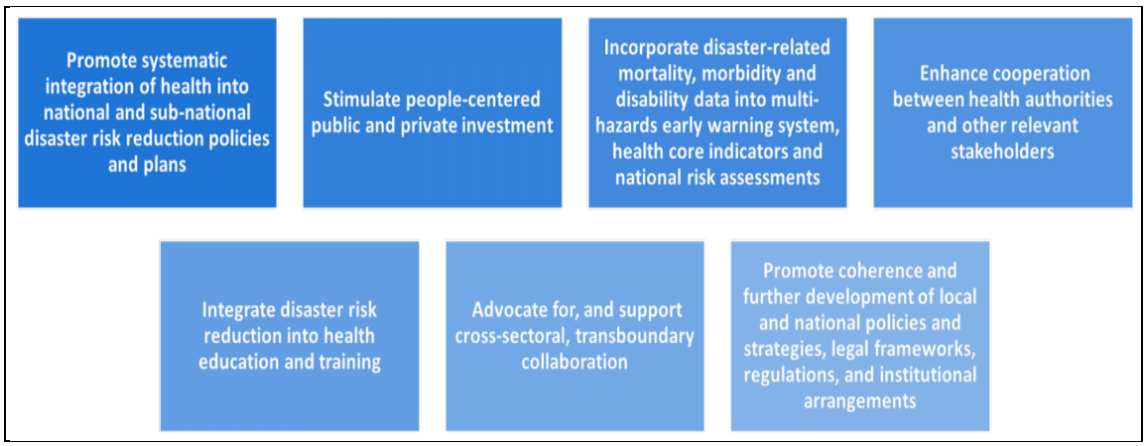

Figure 1: Bangkok Principles for Implementation of the Health Aspects of the Sendai Framework

Through this framework, the European Commission, and its Member States cooperation within the Health Security Committee, including with relevant EU Agencies, such as the European Centre for Disease Prevention and Control (ECDC) and the WHO. Efforts are made also to reinforce the science-policy interface: dedicated centers and partnership networks have been developed including the Mechanism's Knowledge Network and the European Commission's

4. BIOLOGICAL RISK PREVETION, MITIGATION AND MANAGEMENT

In order to prevent assess biohazards we must recall that is better prevent than extinguish fires. Biological hazards pose risks and the great impact is in Economy. Biohazard impacts firms and workers in a wide variety of ways. Thus, impacts of workers pass to their families are all together impacted. This implies that all sectors of activities are involved not only the front desk or the client management. A clear example is tourism

Examples of some type of hazards on workers are: in health care professions via contact with human bodily matter, such as blood, tissues, saliva, mucous, urine and feces, because these substances have a high risk of containing viral or bacterial diseases; people who work with live animals or animal products (blood, tissue, milk, eggs) are exposed to animal diseases and infections; short-term exposures to certain wood dusts or crystals of diamonds and glass may result in asthma, conjunctivitis, rhinitis, or allergic dermatitis; museum and library personnel are exposed to molds

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(e.g., *Aspergillus, Pencillium*). Symptoms experienced are attacks of fever, chill, nausea and cough; ocular infections can result from the use of industrial microscope eyepieces (EU 2000, UE 2007)

Elimination of the source of contamination could be done by developing engineering controls of infrastructures such as improvement of ventilation, isolation of the contamination source, installation of separate ventilation and air conditioning system, use of ultraviolet lamps or other meanings.

If the contact with biological hazards cannot be prevented within infrastructures, all workers must use personal protective equipment such masks, gloves, protective clothing, eye shields, face shields and shoe covers. Today and in future seen attendant wearing protective equipment will be more common and firms will change an attitude of fear emotional impact of customers seeing protective features in all point of sales.Every risk assessment must consider the notion of associated costs and benefits, or any other societal, economic or ethical aspect linked to the biological hazard or the potential socio-economic impacts

Approaches in assessing the risks of biological hazards differ according to the purpose of the assessment like Strategic Risk Assessment (SRA), Rapid Risk Assessment (RRA), Post-event assessment (PA). While assessing the risk of biological hazards can be challenging owing to their unique characteristics like Agent diversity, Routes of transmission, Pathogenicity and virulence, Hazard identification, Endemic diseases with potential for epidemic transmission, Sensitivity to climate, environmental or land use changes. (US 2012)

Tools used to assess hazards could be appropriate from quality management tools. I.e. the use of Ishikawa (1976) diagrams (also called fishbone diagrams, herringbone diagrams, cause-and-effect diagrams, or Ishikawa). The Ishikawa method uses causal diagrams created by Kaoru Ishikawa that show the potential causes of a specific event. Each cause or reason for imperfection is a source of variation. Causes are usually grouped into major categories to identify and classify these sources of variation.

Aveni & Pinho (2020) argue that another way to assess risk is to use ISO 31000 This is a technical standard for managing risk. ISO 31000 working group claims that • most human activities have risks and a risk management standard is useful and necessary. The IEC Advisory Committee on Safety has withdrawn support from ISO 31000, arguing that:

- Security risks are a special case and should not be included in the overall risk management analysis and process.
- Any risk to people is not acceptable.

ISO 31000 is the Risk Appetite or willingness to take risks. This is the definition of the type and size of the risk that each organization is prepared to deal with and achieve, assume or pay, following its objectives. It is a balance between the potential costs of threats and the benefits of innovation and change. It serves to guide employees on the risk allowed for the entire organization.

ISO 31000 has advanced in the definition of risk, stating that this is the effect of uncertainty on the organizational ability to achieve its explicit objectives. Risk diverts the organization from its path towards its goals, because of uncertainty. Uncertainty is also caused by a lack of information.

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The main question to assess biological risks is to have clear in mind that risks is a combination of probabilities and definitions of impacts that asks: what can go wrong? What else could go wrong? If the risk happens, what would be the impacts? In other words, it is possible to quantify the risk as the sum of the impacts by probability of the event.

Therefore, ISO 3001 suggests the use of a matrix which relates the probability of the event (frequency) with the impacts (consequence). It is possible to use colors to show a comfortable situation in green, when we have a low probability of occurrence and a small impact (left side below). For example, forgetting your wallet to do your shopping close to home is very unusual and the impact is, at most, returning home if the store does not offer credit to a known customer. The opposite situation may have a red color, it is a very frequent case, with catastrophic impacts. It is recommended to prioritize risks of high severity, and subsequently those of medium and low severity

Another fundamental concept to manage risk is perform the Control phase, "as it modifies / maintains risks", that is, the responses that will be presented to the risks are influenced by the risk assessment at the respective levels.

Following ISO 31000, the context and scenarios must be established and then perform the risk management process (Risk Management Process), namely:
1. Risk Identification: structure a list as wide as possible of risks.
2. Risk Analysis: understand the causes.
3. Risk Evaluation: predispose the risk analysis matrix.
4. Risk Treatment: establish the responses and controls of risks.

In accordance with Aveni & Pinho (2020), based on ISO 31000, before the actions, it is necessary to define the type of control desired. Thus, two alternatives are possible, that is, mitigate the risk or do nothing. If this analysis were used to complement the strategies proposed by international agencies, for each possible strategy, in each phase we will have a tree of this type. That is, each suggested strategy will have a response, a control, actions and expected impacts.

In case of impacts for each strategy, it is possible to carry out a probabilistic assessment of the result of the action that provides a quantitative value, for example, of increase or decrease in GDP, spending on assistance, number of people with influenza, deaths etc.

To make impact calculations, some investment analysis is needed to assess the status quo, that is, the situation prior to the outbreak and subsequently evaluate the probabilities of each alternative with a tree or at least a check list.

Below is shown EU-OSHA guideline to check biological hazard all organization ought to follow managing biological hazard:

GENERAL CHECKLIST PART A		DOES THE HAZARD EXIST AT THE WORKPLACE?	
QUESTIONS	**1 – WORK ACTIVITIES**	**YES**	**NO**
1.1	Are workers in direct contact with humans?	☐	☐
1.2	Are workers in direct contact with animals?	☐	☐
1.3	Are workers in direct contact with soil or plant materials?	☐	☐
1.4	Are workers in contact with water – plain, spray or aerosol?	☐	☐
1.5	Are workers in contact with any kind of natural products?	☐	☐

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GENERAL CHECKLIST PART A		DOES THE HAZARD EXIST AT THE WORKPLACE?	
QUESTIONS	**1 – WORK ACTIVITIES**	**YES**	**NO**
1.6	Are workers in contact with natural or processed food products?	☐	☐
1.7	Are workers in contact with human or animal solid or liquid wastes?	☐	☐
1.8	Are workers in contact with human or animal body fluids?	☐	☐
1.9	Are workers in contact with human or animal corpses?	☐	☐
	2 – WORKERS		
2.1	Are workers unaware of hazards they are being exposed to?	☐	☐
2.2	Are some workers particularly at risk of biological diseases: pregnant workers, workers with allergies or asthma, low immune system?	☐	☐
2.3	Are pregnant workers in contact with biological agents?	☐	☐
2.4	Are workers and management unaware of the chain of infection? and possible routes of entry and transmission of the biological agents: inhalation, ingestion, absorption through the skin?	☐	☐
2.5	Do you have cleaners or maintenance staff that may have contact with biological agents (e.g. if they empty waste containers)?	☐	☐
2.6	Should warning and safety signs used at the workplace? Do workers have to use warning or safety signs?	☐	☐
2.7	Are new or young workers in contact with biological agents?	☐	☐
2.8	Are there workers for whom the national language is a foreign language? (Do workers have difficulty understanding the national language?)	☐	☐
	3 – WORKPLACE		
3.1	Is waste material disposed of without special measures? Is waste material disposed of in an unsafe manner? Is waste material easily accessible?	☐	☐
3.2	Are workplaces cleaned irregularly and without disinfection?	☐	☐
3.3	Are separated restrooms for workers missing?	☐	☐
3.4	Do the workplaces need ventilation?	☐	☐
3.5	Are workers unaware of (uninformed about) the results of any exposure monitoring or health surveillance?	☐	☐
	4 – WORK ORGANISATION		
4.1	Should the proper implementation of established procedures be checked?	☐	☐

Source European Agency for Safety and Health at Work (EU-OSHA) - http://osha.europa.eu 1

At last, it is also important to distinguish prevention (which is a response to a known risk) from precaution. According to the European Commission[4] the precautionary principle can be invoked when the potentially dangerous effects deriving from a phenomenon, product or process have been identified through scientific and objective evaluation, but this evaluation does not allow the risk to be determined with sufficient certainty[5].

In some way is the WHO classification of biological hazard that does not imply pandemics. This precaution is related more to identification of risk, which is undetermined, while WHO praise to consider less hazardous when the evaluation is clear and determined. As strategies the management of such a risk results on minor probability of great impacts but not less risk.

Resorting to the precautionary principle is only justified when three preliminary conditions have been met: the identification of potentially negative effects, the assessment of available scientific data and the degree of scientific uncertainty.

5. CONCLUDING REMARKS

[4] (Communication from the Commission of 2 February 2000 on the use of the Precautionary Principle (http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52000DC0001)),
[5] Available at: https://www.biosafety.be.

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We discussed a framework reference for biological hazard management and assessment tools because we want to see in future that all organization rethinks and (re)makes overall risk assessment and particularly biological hazard risk assessment. We started form lessons from Covid-19 all over the year 2020. We need new voluntary and general rules to change our approach of biological risks, till today very amateur and not coordinated. We need use our techniques, information and knowledge to reduce biological hazards and generally risks, especially the ones that impact or environment and increase communities' benefits, not only firms and government ones.

A biological hazard approach to reduce social and economic impacts must be improved especially for our health systems and health economy. If everyone had had the right information and education and organizations had voluntary assessed biological risks, the draconian solutions, like lockdown, especially not well coordinated, weren´t needed. Using preventions and plans for mitigation and improvement of safe protocol would result of protocol just in time before pandemic outbreak reducing overall impacts and social costs.

Our great resource to solve the pandemic problem is not only the Health System (that cure when the biological hazard has hit society) but research and development of vaccines, have reserve and flexible capacity for health systems, our attitude and use of our knowledge to prevent the hazard and mitigate it.

Virus like Covid-19 and other hazards are not disappearing only with a vaccine. Only a coordinated and herd vaccination all over the world, and this included all rich and poor countries, at the same time could prevent new outbreaks in future, so we must prevent new outbreaks and other possible hazards we can´t foresee now. That is why we need more professional risk analysis and risk management today and in the future.

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