Risks, hazards, harm and risk analysis: a brief introductory overview for veterinarians

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Abstract

Risk is a probability that an unfavorable event or harm (e.g., illness) will occur due to exposure to a hazard. Hazard is the agent or factor that brings about harm. It may be a pathogenic agent, a characteristic of an individual or of the herd, or some extrinsic factors (e.g., the environment) that causes or increases the likelihood of harm. Harm may be an unfavorable health eventuality or a dire consequence that is caused by specific hazards and risks. When we consider these three interwoven concepts, we get Risk Analysis. Risk analysis has several interconnected components: Hazard Identification, Risk Assessment, Risk Management and Risk Communication. Risk analysis, as a framework of assessing the likelihood, causes and consequences of unwanted health related phenomenon, is very important in discussing zoonotic infectious diseases (e.g., Bovine Spongiform Encephalopathy and Highly Pathogenic Avian Influenza), laboratory biosecurity and biorisk management and disease prioritization. At the core of this principle and framework is the aim of limiting the occurrence of a harmful consequence while keeping in mind the benefits of the planned and implemented management efforts. The aim of this article is to succinctly introduce risk analysis as a framework, its components, and its application in veterinary science and medicine.

Keywords: Harm; Hazards; Risk; Risk Analysis; Veterinary Medicine

Introduction

Risk is a probability that an unfavorable event or harm (e.g., illness) will occur due to exposure to an identified hazard. Considered also within the discussion of risk is the severity of untoward consequences that a hazard may cause (Cohrssen & Covello, 1999). Meanwhile, hazard is the agent or factor that brings about harm. It may be a pathogenic agent, a characteristic of an individual or of the herd, or some extrinsic factors (e.g., the environment) that causes, or increases the likelihood of, harm (Jardine et al., 2003; Chung, 2006; Tenorio, 2022a). Risk is quite different from a hazard but the two are inextricably linked. Risk is the likelihood of the occurrence of a harmful event that is caused by a hazard. One does not occur without the other. There is no risk or likelihood of its occurrence if the hazard is absent and vice versa. On the other hand, harm is the unwanted consequence of the increased risks and exposure to hazards (Cohrssen & Covello, 1999). Harm may be an unfavorable health eventuality or a dire consequence that is caused by specific risks and hazards. Considering these three interwoven concepts, we get Risk Analysis. The OIE Terrestrial Code states that the aim of risk analysis in animal health, especially in international trade, is "to provide importing countries with an objective and defensible method of assessing the disease risks associated with the importation of animals, animal products, animal genetic material, feedstuffs, biological products and pathological material" (World Organization for Animal Health, 2020). The aim of this article is to succinctly describe risk analysis as a framework, its components, and its application in veterinary science and medicine.

Components of Risk Analysis

Risk analysis has several interconnected components (Figure 1). The first one is Hazard Identification. As the name implies, it involves pointing out specific agents or factors that may cause harm (Supriyadi & Ramdan, 2017). What is to be identified may be an important pathogen that can dismantle an industry once introduced in a zone or a food manufacturing procedure that increases the risk of contamination of consumable goods. In terms of international trade, important aspects of hazard identification include: 1) identification of hazards that are appropriate to the species or commodity to be imported; 2) assessing the presence of the hazard in the exporting as well as the importing country; 3) categorization whether the hazard or disease is notifiable internationally or nationally; and 4) assessing the control and surveillance efforts exerted by the exporting country (World Organization for Animal Health, 2020).

The second component of risk analysis is Risk Assessment. This refers to the process in which the likelihood of a harm caused by a hazard or hazards identified is estimated qualitatively (thru descriptions and categorizations) or quantitatively (thru numerical estimation and rankings) (Vermeire et al., 1999). The World Organization for Animal Health (2020) describes several steps in conducting risk assessment. First is Entry Assessment – it measures the likelihood of hazard entry into a country, zone or compartment; it considers the biological nature of the hazard, factors of the country and factors of the commodity affected by the hazard. Second is Exposure Assessment – it aims to describe and assess the necessary biological pathways needed for hazard exposure. What is identified and evaluated in exposure assessment are conditions conducive to exposure (e.g., amount of hazard, temporal factors, spatial factors, route of exposure, and number of species affected). Third is Consequence Assessment which aims to assess the would-be effects of hazard exposure; a causal analysis should always be present (i.e., exposure induces adverse health and economic effect). And lastly, Risk Estimation takes into account the results of all the steps of risk assessment and aims to produce measures that would abate all risks associated with the identified hazard.

The third – and arguably the most crucial – part of Risk Assessment is Risk Management. It is the stage in which efforts are planned and enacted in order decrease the risk to an acceptable level (Boyle, 2019). This is usually done after the risk assessment. Results of the assessment are used to draft recommendations, policies and guidelines. It is in this stage that all the options to mitigate the risk, hazard and possible harm are considered based on their possible costs and benefit (Jardine et al., 2003). Moreover, the level of risk aversiveness and tolerance is established in this stage. Figure 2 briefly summarizes the components of risk management according to the World Organization for Animal Health (2020).

The last component of Risk Analysis is Risk Communication, which involves exchanging and disseminating information regarding the risk analysis model. It involves dialogues and exchanges with internal communication links (between risk assessors and managers) as well as external communication lines (between a company and their stakeholders) before policies are implemented (Rothman & Kiviniemi, 1999). The goal is to inform everyone that is substantially involved in the process of the actions and efforts made to address risks, the hazards that influence this likelihood, and the harmful consequences that the latter causes (Abrams & Greenhawt, 2020). As an important component of risk communication, peer review is encouraged so as to ensure that sufficient scientific critique and evaluation of the risk analysis and measures are gathered (World Organization for Animal Health, 2020). It also to guarantees that that data, information, methods, and assumptions in the formulated risk analysis model are up to date.

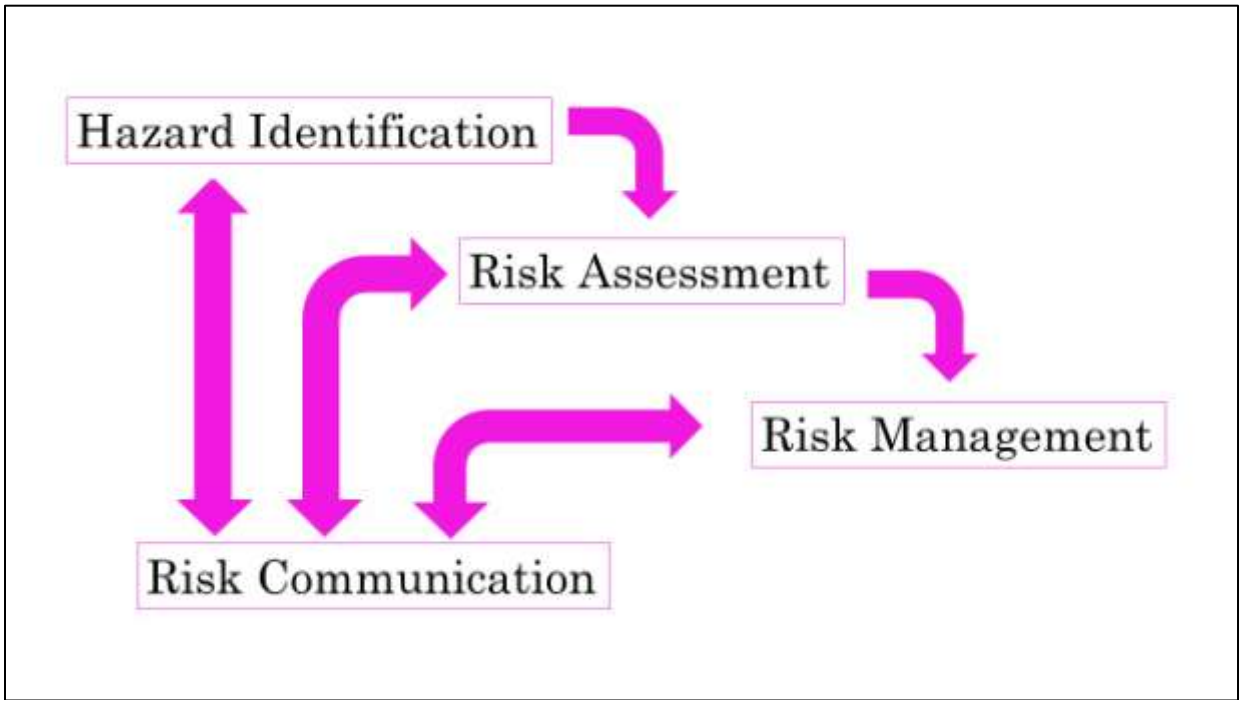

Fig 1. Components of risk analysis and how they are interconnected

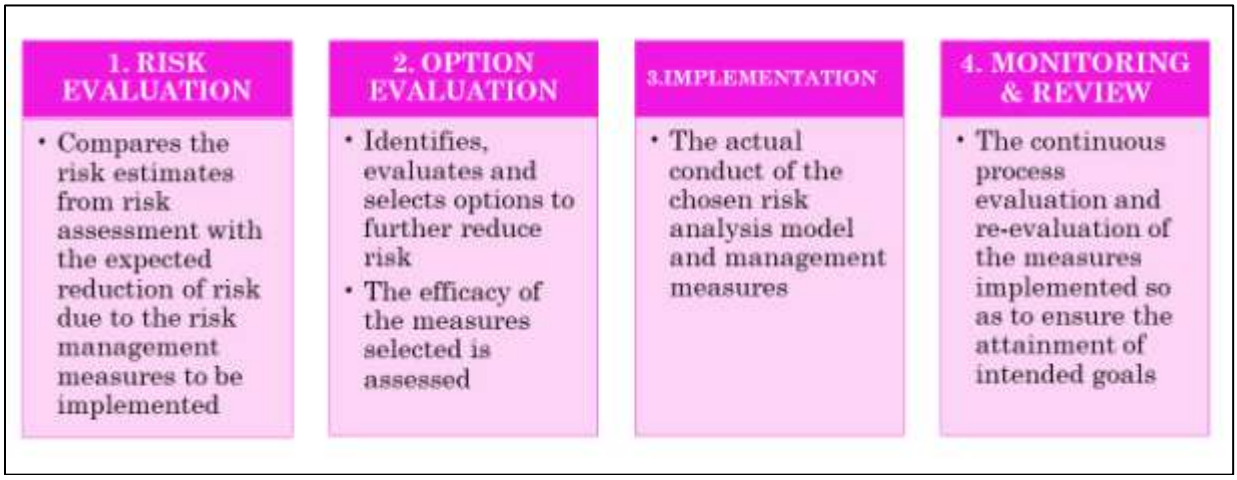

Fig 2. The components of Risk Management, as discussed by the World Organization for Animal Health (2020)

Risk analysis & zoonotic infectious diseases: some veterinary applications

Risk Analysis as a framework of assessing the likelihood, causes and consequences of unwanted health related phenomenon is very important in discussing zoonotic infectious diseases. The tool is vital in preventing entry and proliferation of established zoonotic diseases to a country, zone, or compartment. For example, there used to be a widely applied, risk-based ban on the importation of beef and bone meal from the United Kingdom to prevent the entry and spread of Bovine Spongiform Encephalopathy or Mad Cow Disease during the 1980s-90s (Stevenson et al., 2005; Wyne & Dressel, 2010). Another example is the Philippines' continued surveillance on migratory birds and waterfowl populations for Highly Pathogenic Avian Influenza (HPAI) is a product of risk assessment (Tiongco, 2009; Wieck et al., 2012; Tenorio, 2022b). We know by now that these avian species have the capacity carry and bring HPAI viruses to our country. Thus, their natural inclination to migrate to our country during the hotter months present as increased risk of an HPAI outbreak. The importance of this point has been highlighted due to the recent entry and spread of H5N1 HPAI in the Philippines, where surveillance efforts and guidelines on the movement of poultry and their products have been put in place to reduce the risk of aggravating the outbreak (Philippine Department of

Agriculture, 2022a & 2022b). Another application of Risk Assessment on zoonotic diseases is within the confines of laboratories that handle disease-causing hazards. Special protocols and containment measures are put into place so as to prevent the inadvertent, unintentional – or otherwise – exit and spread of pathogens from laboratories to the general populace (World Health Organization, 2020). Biosecurity measures based on risk analysis keep bad microbes from the hands of bad people. Also, these measures allow for occupational health strategies and protocols that ensure the safety of those who are exposed to these bad microbes. Risk analysis as a gauge is also heavily used in the prioritization of diseases, both in animal and human health. Those with dire consequences and increased probability of occurring are prioritized highly and those which are unlikely to occur and have considerably manageable health consequences are considered but are not of heightened priority (Van Vaerenbergh et al., 2010).

Conclusion

In general, Risk Analysis is important because it is a way of keeping harmful phenomenon that may lead to catastrophic consequences at bay. Thru the identification of specific hazards and thorough assessment of their associated risks, one can construct and apply specific efforts to manage and hopefully limit the likelihood of occurrence of specific harms to an acceptable level. However, it is important to note that there are circumstances that a zero-risk approach may not be feasible. However, lowering the risk to a level that limits the harm a hazard causes is already a winning situation. At the core of this principle and framework is the aim of limiting the occurrence of a harmful consequence while keeping in mind the benefits of the planned and implemented management efforts.

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