A REVIEW ON OCCUPATIONAL SAFETY AND HEALTH RISKS ASSOCIATED WITH ANIMAL WORKERS

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ABSTRACT

Background: Issues pertaining to hazard identification and Occupational Safety and Health (OSH) risk management in industrial settings have often been explored and reported in literature. Personnel who work in close proximity with animals especially non-domestic animals are exposed to specific occupational safety and health risks uncommon to existing industries. To minimize these associated risks, there is a need to identify the risk factors which are common within this occupational setting. Currently, there is a lack of published literature which focuses on these workers. This paper aims to provide a traditional literature review on OSH risks associated with animal workers. The outcome of this paper will help in providing summarised information crucial in determining the control methods required to improve OSH performance. Improved OSH performance will ensure the safety and health of workers within this group is protected.

Materials and Methods: This review uses the methods of literature search as the main methodology. Existing literatures in English languages from year 1998 to 2018 were identified. The database search was inclusive of Scopus, Science Direct, Google Scholar and PubMed. In total, 33 articles were found from which only four studies which met the inclusion criteria were selected for this review.

Result: Of the four studies, one study was from Australia, one from India, one from the United States of America (USA) and the other from Tanzania. Overall, this review found that animal workers which consist of veterinarians, animal health workers, livestock keepers and animal handlers in zoo are exposed to risk not limited to zoonoses, but also to injuries arising from working closely with animals. Zoonotic diseases reported include rabies, tuberculosis and anthrax while injuries consist of superficial scratch to animal bites. Control methods reported include training on protection of zoonosis and the use of personal protective equipment (PPE) to prevent animal-related disease. No other types of control methods were reported.

Conclusion: Evidence found from this review indicated that animal workers are exposed to OSH risks not limited to biological hazards only while handling or working closely with animals. The use of control methods such as administrative control which includes training and the use of PPE were reported to mitigate the risk of hazards especially those related to zoonosis only but not those related to preventing injury. Therefore, there is the need to implement more comprehensive OSH risk management to reduce risk to various hazards.
among workers who works in close proximity of animals such as in zoological setting. Training on risk exposures will help protect the workers from any safety and health risks is essential to be implemented in zoo programs to assess, evaluate thus reducing unnecessary OSH risks for animal workers.

Keywords: occupational health and safety, zoo, veterinary workers, workplace-related illness and injury

1.0 Introduction

Animal worker or zoo keeper is a term used to describe an individual who cares for animals in zoological parks or aquariums, but also encompasses other career titles such as Animal Trainer, Aquarist, Biologist, Aviculturist and Herpetologist among others. A career as an animal keeper offers a unique opportunity in the specialized and demanding profession of maintaining captive exotic animals for conservation, research, public education and recreation. The hazards associated with handling animals can be loosely divided in three major categories namely physical (trauma), chemical and biological (allergen) hazard. (Jeyaretnam & Jones, 2000), in addition to common hazards associated with manual work involving taking care of animals.

First, physical injuries occur from bites and scratches, especially from rodents, rabbits, dogs and cats. Secondly, the possibility of zoonotic diseases must always be considered. Zoonotic diseases are those that can be transmitted from animals to humans. Thirdly, there are serious allergic hazards associated with breathing or contacting animal dander or urine allergens among others. Due to several emerging infectious and zoonotic disease outbreaks occurred, Malaysia has gathered a team from different expertise and specialties to collaborate as one, goal of One Health (Habib, 2017). The creation of One Health Manual on Handling Disease Outbreaks in Malaysia provides the opportunity to understand the invaluable roles in zoonotic disease prevention and control (Malaysia One Health University Network (MyOHUN), 2017).

The International Labor Organization (ILO), (2012) estimated that 4% of annual global Gross Domestic Product, or 2.8 trillion USD, is lost due to the direct and indirect costs of occupational accidents and diseases, including lost working time, workers’ compensation, interruption of production, and medical expenses. According to CNN, animal advocacy group Born Free reports that there have been 256 injuries in zoos due to animal attacks over the past 26 years until 2016, resulting in 33 deaths (Romain, 2016). A report from Hospital of the University of Pennsylvania also stated that from 1990 to 2011, there are 300 dangerous cases involving wild animals and between 1990 to 2010, 172 wild animals escaped with unclear number of recaptured or killed in the United States alone (Shepherd et al., 2014).

The health problems such as allergic diseases, unlike the immediate effects of an injury can be developed unnoticed over time. Thus, in managing the occupational safety and health (OSH) in zoos, the focus on the knowledge and awareness of potential risks and hazards must be considered as it can reduce the likelihood of any injuries at work or related ill-health effects (Health and Safety Executive (HSE) 2012).
Clearly, at all zoos, OSH of the workers when working with animals is a key area to consider. However, it is important to remember that most of the accidents occurred at zoos also result from slips and trips, manual handling and vehicle movements, and a third of these accidents are to visiting members of the public (HSE, 2012). Therefore, when thinking about safety and health at zoos, it is essential that these issues are being considered, as well as those directly related to working with animals. Undoubtedly, such close proximity with animals makes animal workers as a high risk group for suffering from various zoonotic diseases.

Several of these viruses have resulted in significant morbidity and mortality to those affected and they have imposed a tremendous public health and economic burden on the state. Amongst zoonotic diseases prevalent in Malaysia are Enterovirus 71, Nipah virus, Tioman virus, Chikungunya virus, rabies and Highly pathogenic avian influenza (H5N1) (Tee, Takebe, & Kamarulzaman, 2009). The prevention of such health hazards to the animal workers, one of the prime steps is to understand their perception of such potential risk and a quantitative assessment of the risk, so that it can be use of as risk reduction by using questionnaire with questions pertaining to zoonotic diseases, animal related allergic manifestations and injuries. The risk assessment also carried out by administering incidents of injury or any past history of zoonotic diseases among zookeepers at workplace as one of the ways in risk reduction (Bagaria & Sharma, 2014).

Studies in this field are very limited throughout the world making it one of the least studied areas (Bagaria & Sharma, 2014). Likewise, a few researchers have also tried to investigate the knowledge and attitude of animal workers relating to prevention of transmission of zoonotic diseases and injuries. In a study conducted in United States of America, there are a lot of potential hazards encountered by animal control officers as well as the employees of zoo and aquarium facilities such as animal escape, respiratory tract illnesses, zoonotic diseases and a lot others. The suggested protocols for ensuring a safe and healthy workplace were also being introduced and presented to the facilities. (Swiderska-Kielbik, 2009; Swiderska-Kielbik, 2010; Bagaria & Sharma, 2014).

In view of the knowledge gaps in this field, a review of the current literature related to OSH risks associated with animal workers is warranted. As such, the aim of this paper was to provide a traditional review of the literature on OSH risk factors associated with animal workers. The findings of this study will enable risk factors in animal handling to be identified, measured thus restraint and minimize the risk of injury to the workers.

2.0 Materials and Methods

This is a traditional systematic review which included original research articles only. The populations of interest were the animal workers directly involved in taking care of animals especially in zoo industry.

2.1 Identification of Publication

The databases included in the search were Scopus, PubMed, Science Direct, and Google Scholar. Studies published in English from 1998 to 2018 and full text articles were considered.
for inclusion in this review. Keywords that were searched in each database included but not limited to: (occupational risk) AND (zoo).

The literature search strategy identified 33 potentially relevant studies (Figure 1). Figure 1 provides an overview of the strategy used to identify articles that met the inclusion criteria which includes cross sectional study design. Initially, the articles were screened resulting in 18 articles being excluded from this review due to study’s findings other than those not directly in contact with animals. The remaining 14 studies were assessed for inclusion. Exclusion of the paper was made by determining publication in a language other than English. As results, a total of eleven studies were excluded and in total four studies met the inclusion criteria for this paper review.

3.0 Results

This paper reviews four selected papers on the study of OSH risk factors associated with animal workers and that were published in 2008 to 2018. From all four studies, (Bagaria & Sharma, 2014 from India with 66 respondents; Hill et al., 1998 from USA with 312 respondents; Dowd et al., 2013 from Australia with 344 respondents; Swai et al., 2010 with 79 respondents), two studies were conducted within veterinary association (Hill et al., 1998; Dowd et al., 2013) one study was conducted at zoological park (Bagaria & Sharma, 2014) and one study conducted among animal health workers and livestock keepers (Swai et al., 2010). All four studies using self-administered questionnaire with two studies involved veterinarians and animal control officers (Hill et al., 1998; Dowd et al., 2013), and one study involved zookeepers (Bagaria & Sharma, 2014).

![Figure 1: Flow diagram of article screening and selection. The figure provides an overview of strategy used to identify articles that met the inclusion criteria. In total, 4 studies met the inclusion criteria for this review.](image-url)
Table 1: Table shows four selected review articles used in this research study on OSH risks among animal workers from the year 2008-2018

<table>
<thead>
<tr>
<th>Author / year / country</th>
<th>Design and study title</th>
<th>Study location</th>
<th>Population</th>
<th>Methodology</th>
<th>Findings</th>
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<tbody>
<tr>
<td>1. Bagaria A. &amp; Sharma A. K (2014), India</td>
<td>Cross-sectional study (A Knowledge and Practices Study of health hazards among animal handler in zoological garden)</td>
<td>Zoological park New Delhi</td>
<td>66 employees including animal handlers</td>
<td>Questionnaire</td>
<td>86% perceived risk of suffering from disease or injury due to animal handling. Allergies, tuberculosis and bird flu were the common zoonosis risk perceived. Most workers were vaccinated for tetanus (65%) and rabies (37%). There were reports of symptoms related to zoonotic disease such as headache (83.3%), itching (80%) and vomiting (79%). About 60% reported injury while handling animals and were then taken to doctor for treatment. Injuries include superficial scratches (37.9%) followed by deep wound (34.4%) and animal bite (17.2%). About ¼ workers reported attending training program.</td>
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<td>2. Dowd K. et al., (2013), Australia</td>
<td>Cross-sectional study (Zoonotic disease risk perception and infection control practices of Australian veterinarians: Call for change in work culture)</td>
<td>Australian registered veterinarians attending the 2011 Australian Veterinary Associatio n (AVA) Conferenc e</td>
<td>344 veterinarians</td>
<td>21 closed, semi-closed and open questions</td>
<td>This study determines the perception of risk among veterinarian on zoonotic disease. 45% respondents reported contracting zoonosis during their career with 25% reporting confirmed incidence. 40-60% perceived exposure to zoonosis is likely. The use of personal protective equipment (PPE) was less than adequate when compared to Australian industry guidelines. Workplace policies and culture influence the use of PPE. Efforts like training and supporting staff were suggested to be incorporated into work to improve the work culture,</td>
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<tr>
<td>3. Hill et al., (1998), America</td>
<td>Cross-sectional study (Occupation al Injuries and Illnesses Reported by Zoo Members of American Associatio n of Zoo Veterinaria ns)</td>
<td>315 veterinarians</td>
<td>Self-administered 14-page questionnaire</td>
<td>Significant findings include major animal-related injury (61.5%), back injury (55%), necropsy injury (44.1%), adverse formalin exposure (40.2%), animal allergy (32.2%), zoonotic infection (30.2%), and insect allergy (14.2%). Gender, length of</td>
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Veterinarians in the United States

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<thead>
<tr>
<th>Researchers</th>
<th>Study Title</th>
<th>Study Design</th>
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<th>Sample Size</th>
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</tr>
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<tr>
<td>Swai et al., (2010) Tanzania</td>
<td>Cross-sectional study (Knowledge and attitude towards zoonoses among animal health workers and livestock keepers in Arusha and Tanga, Tanzania)</td>
<td>Tanga and Arusha regions, northern Tanzania</td>
<td>79 respondents consisted of animal health workers and livestock keepers</td>
<td>Questionnaire-based survey</td>
<td>The results demonstrated that rabies (45.8%), tuberculosis (50%) and anthrax (62.5%) were considered three most common zoonotic diseases. Patchy awareness and knowledge of zoonoses, combined with food consumption habits and poor animal husbandry are likely to expose respondents to an increased risk of contracting zoonoses.</td>
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Overall, all four of the review studies (Bagaria & Sharma, 2014; Hill et al., 1998; Dowd et al., 2013; Swai et al., 2010) showed that they perceived a risk when handling the animals which highlights the need for looking after the animal workers safety and health and mitigating risk of zoonotic diseases. Top three risk perceived from all three studies are animal attack with 65.1% (Bagaria & Sharma, 2014), zoonoses with 40-60% (Dowd et al., 2013) stuck by needle sticks with 86.7% (Hill et al., 1998) and rabies with 92% (Swai et al., 2010). Dowd et al., (2013) reported that the veterinarian were able to identify hazards and the substantial improvements needed for the implementation of infection control practice and change the work culture by training and supporting staff including the use of personal protective equipment (PPE).
Figure 2 shows the illustration made from a study by Hill et al., (1998) that shows animal control officers and aquarium workers are exposed to these five categories that demonstrated a greater need of preventive or safety measures to establish a comprehensive safety and health workplace environment and reducing workplace risk exposed to workers. Bagaria & Sharma (2014) reported that the majorities which is 86% of the respondents knew that it was necessary to know where the animal is before entering an enclosure or back area. Only a few animal handlers had taken training or attended workshop regarding prevention of zoonotic diseases and injuries due to animal handling. It also reported that none of the workers had ever been told by a physician if he or she was suffering from a disease due to animal handling.

4.0 Discussion

The risk factor for the development of the safety and health risk at workplace was studied and it shows that several diseases and illness were cause by the animals. People who work closely with animals are more likely to be infected with occupational zoonoses. Zoonoses are infections naturally transmitted between vertebrate animals and humans (Swai et al., 2010). It is also important to note that more than 70% of the emerging zoonotic diseases have wild animals as reservoir hosts. The major zoonotic diseases that are transmitted to humans include rabies, anthrax, leptospirosis, Q-fever, psittacosis, hendra virus, nipah virus, herpes B encephalitis, toxoplasmosis, etc. (Kumar et al., 2013). This is where knowledge and attitude on occupational safety and health is essential to be trained to all workers pertaining to their safety and health at workplace.

The study from Dowd et al., (2013) successfully showed that the evaluated infection control practices used by veterinarians and some other factors associated with the use of PPE have
been identified. This study was conducted to identify veterinarians’ perceptions of zoonotic disease risks, the infection control practices they use to protect themselves from being infected to zoonotic diseases and the factors influencing these practices. Risk perceived from zoonotic infections was a significant driver for adequate use of PPE, as those perceiving the likelihood of zoonotic exposure to be low, were less likely to use adequate PPE possibly exposing themselves to a higher risk of zoonotic infections.

The finding was not sufficient to suggest that risk acceptor individuals who don’t take any priority of safety or any health hazards associated with its exposure. However, the results do show that the way risk acceptor individuals handle risk exposure might be a bit different with the risk averse individuals (DellaValle, 2012). This is when risk averse personality need to be trained to all workers to reduce the risk or any hazard thus creating a safety and health environment in an organization. Risk averse personality can be implemented by organizing a safety and health training programs aimed at reducing the zoonotic infection exposure as an example.

In addition to education and awareness, liability was the other factor that influenced the use of PPE at workplace. A report from SafeStart (n.d) state that the workplace safety and health plays a major role in overall PPE compliance. There are several methods to promote a stronger safety and health, including giving workers a method of reporting problems regarding PPE, offering positive encouragement when employees properly use of the equipment and also providing a proper channel for employees to discuss safety issues. Failure to equip with what is considered as safe work environment or to protect employees from risk exposure materials within the workplace could have serious legal implications for veterinarians regarding duty of care, which may be translated into legal liabilities (Babcock et al., 2008; Dowd et al., 2013).

Veterinarians use of PPE is associated with their perception of the risks, and their determination of risk must necessarily be grounded in their knowledge base and their attitudes, such as their ability to control the threat or any hazard. Increasing information on the exposed risks may help to bring veterinarians use of PPE more closely related with zoonotic disease risks. Animal workers like zookeepers, zoologist, volunteers and others also need to consider using a proper PPE to avoid such injury or hazards as they are also spending their daily work schedule in contact with the animals. Good quality training can increase the knowledge about zoonotic disease risks and refining the quality of decision making about the use of PPE in different practice context and thus improving the attitude of workers towards establishing a safety and health environment.

According to Hill et al., (1998) the highest frequent reports injury was the needle sticks injury by 86.7%. Majority of the respondents reported recapping needles. One of the methods is the one hand scoop method that involves the scooping up the needle cap with the needle in one hand and afterwards secures the needle cap with the other free hand. Another safety preventive measures that can be implemented are by training and educating personnel. Major animal related injuries were the second most frequent occupational injuries happened. Hospitalization was due to animal bites and scratches, surgery to repair tissues or tendons, broken bones, broken nose, spleen or liver thrombosis and back spasms are results from crush injury. Through these results, it clearly showed that there’s lack of knowledge and training regarding the safe use of PPE, safety procedures and also the proper attitude when handling their work duties.
In almost every industry, musculoskeletal injuries and disorders in the workplace are among the most prevalent causes of lost-time injuries and illnesses (DiNardi, 1997; Hill et al., 1998). Back injuries appear to be the most prevalent ergonomic injury in the zoo veterinary medical practice. Whenever lifting is done, the load should be kept close to the body, and it is best to lift at the knees without twisting (Mackinnon & Novak, 1994; Hill et al., 1998). Therefore, tough or heavy workload in combination with high force requirements should be avoided. Self-pacing and task variability in terms of posture and motion are highly recommended (Mital, 1996; Hill et al., 1998). In Malaysia, the workers are still using manual handling when lifting heavy loads. Even though the load beyond the workers capability, manual handling still be their first choice in their daily work. This practice may results in ergonomics like back pain injury, musculoskeletal disorder injury and others. Zoological institutions can start developing and implementing a program by completing a workplace analysis of animal workers daily practice to identify ergonomic risk factors for back or upper extremity problems.

Psittacosis or ornithosis is a zoonotic illness caused by *Chlamyphila psittaci*, which occurs either sporadically or in small outbreaks. *Chlamyphila psittaci* infection usually occurs when a person inhales organisms aerosolized from dry faeces or from respiratory secretion, viscera or feathers of infected birds (T. F. Raso et al., 2008). In addition, the study from A. Krakowiak et al., (2002) reported that hyperallergic predisposes to the development of allergic diseases were most likely caused by animal fur and feathers. The bird keepers employed at zoological garden or any institution were most likely exposed to these workplace safety and health risk. The findings from the research by Sylwia Świderska-Kielbik et al., (2011) indicate that occupational allergy to birds is an important health problem among zoo bird keepers in Poland. It is due to the allergen exposure from contact with bird feathers, serum or droppings as bird droppings may contain excreted serum protein antigens, that may include bacterial endotoxin and other biological non-specific substances (Bulmer AC & Bulmer GS, 2001; Lutsky I & Bas-Sela S., 1982; Sylwia Świderska-Kielbik et al., 2011).

The frequency of zoo veterinarian infected with animal allergy corresponds with values at the higher end of this range, suggesting a higher prevalence of animal allergy than for the other veterinary practices. This higher prevalence is due to the wide variety of danders, furs, and feathers in the zoo that being exposed. Individuals with a history or having asthma might also have an inherited tendency to develop allergies and should take appropriate precautions (Adelman & Saxon, 1995; Hill et al., 1998). This is where safety measures like using the proper PPE is needed to prevent illnesses. Each zoo should have a safety talk or videos to inform zoo volunteers and also visitors on the safety and health measures as they are also may exposed to illnesses especially if their health is not in their best condition.

Solarz K. et al., (2004) research revealed that animal workers are exposed to allergenic mites. So far, the mites have not been reported as occupational biohazards for workers, but it was considered as occupational risk factors contributing to the occurrence of respiratory and dermal diseases among these workers. The prevalence of poor hygiene practices and lack of dining facilities shown by these results may be contribute to the incidence of zoonotic infections reported. They should have at least annual tuberculosis skin testing. The Centers for Disease Control recommends that individuals with a high likelihood of exposure to rabies virus must be vaccinated or tested more frequently than individuals with rare contact. The American College of Physicians recommends tetanus toxoid booster vaccinations every 10 years for animal workers. As for veterinarian that will be collecting animals directly in the
wild, other vaccines such as those for an thrax, cholera, yellow fever, typhoid, plague, Japanese encephalitis, and hepatitis A and B, should also be considered (Jong & McMullen,1995; Hill at al., 1998).

The study from this review has showed that animal workers were exposed to risk at workplace and there is an association with the knowledge and attitude on occupational safety and health that need to be further studied to gain more in depth information in this industry. Much can be done by education and training to increase the knowledge and skills of different health professionals, and for raising awareness by facilitating communication and inter-disciplinary collaboration on research and/or sharing of information between veterinary, public health, agricultural personnel and policy makers (Coulibaly & Yameogo, 2000; Swai et al., 2010).

5.0 Conclusion and recommendation

From the studies reviewed, it is proven that all animal workers perceived risk when handling with the animals. These studies highlights the existing lacunae especially in their knowledge and attitude about health hazards of animal handling and safe practice. The main risk factors identified was animal handling and these identified risk factors may be used to create a specific training module for the benefits of animal workers. It highlights the need for looking after the animal workers health and mitigating risk of contacting any zoonotic diseases. Better education and awareness of the risk percieved at the zoo should be given to animal workers. All individual involved in handling and care of the animals must be given an induction addressing health and safety issues. Hazards must be considered when allocating tasks. If a risk cannot be managed, they must not undertake the activity. Future studies should analyze particularly in workplace risk injuries and illnesses being exposed to all animal workers as suggested by the results from the reviewed studies.

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Declaration

Author(s) declare that the reviewed paper submitted to IJPHCS for publication, has not been published before nor is considered for publication in another journal. It is also declared that the manuscript has been approved by all co-authors and institutions employing the authors and/or in which the work has been carried out.
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