IMPACT OF PUBLIC HEALTH INTERVENTION ON KNOWLEDGE, ATTITUDE AND PRACTICE OF WORKERS AND Escherichia coli PREVALENCE IN SELECTED CATTLE ABATTOIRS IN MALAYSIA

ADAMU MUHAMMED TUKUR

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By

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Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia in Fulfillment for the Requirements for the Degree of Doctor of Philosophy

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the Degree of Doctor of Philosophy

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June 2016

Chairman : Associate Professor Shamsul Bahri HJ Mohd Tamrin, PhD
Faculty : Medicine and Health Sciences

Background: The public health issues related to meat safety remains a major issue in the 21st century which affects both the advanced and third-world countries. Several outbreaks of diseases linked with food were associated *Escherichia coli*.

Problem Statement: Inadequate provision of equipment and awareness on food safety are some of the factors that accelerate the dissemination of *E.coli* to the environment. An increase in the prevalence of pathogenic Escherichia coli among human population may hospitalization and even deaths.

Justification: Incidence of food poisoning has been increasing over the last decade in Malaysia and *E.coli* was found to be the cause in many instances. Interventions including health education and awareness which focuses on food handlers can serve as a proactive measure in management and prevention of illnesses arising from ingestion of contaminated food items.

Therefore, the main objective of this research focused on assessing the impact of an intervention in improving Knowledge, Attitude and Practice (KAP) abattoir workers and decreasing prevalence of E.coli in some selected abattoirs. Methodology: An intervention program in form occupational, food and environmental safety was conducted in the study. Impact of the intervention was assessed in two phases; pre and post intervention phases. Self-administered questionnaire and sample collections were used for assessment of KAP and prevalence of *E.coli* respectively. Findings: The mean scores for knowledge, Attitude and Practice, in the pre-intervention phase were 7.1±1.87, 4.3±0.73 and 5.5±1.01 respectively. While in the post-intervention phase the scores were 9.4±2.15, 4.7±0.48 and 5.8±0.93 respectively. Comparison of KAP score in pre and post intervention phases indicated significant difference in knowledge ($p=0.000$) and attitude (0.025) but no significant difference was observed in practice scores($p=0.115$) based on the results. Significant reduction ($p=0.04$) in cfu/ml of waste water discharged all abattoirs into the environment was recorded. Carcass contamination was also found to be decreased in all abattoirs ($p=0.033$) after

the intervention. The hands swab samples collected during the study showed that *E.coli* O157:H7 was isolated on hands of workers during work in two locations and the total prevalence during work was 9.4%. Non-O157:H7 was 34.5% in the pre-intervention phase. In the post intervention phase total prevalence during work was found to be 0% for *E.coli* O157:H7 and 27.8% for Non-O157:H7. Conclusion: Based on the findings the intervention program was found to have an impact towards improving workers KAP and reduction of *E.coli* prevalence in the Abattoir.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Doktor Falsafah

KESAN INTERVENSI KESIHATAN AWAM TERHADAP PENGETAHUAN, SIKAP DAN AMALAN PEKERJA DAN PREVALENS *Escherichia coli* DI RUMAH PENYEMBELIHAN LEMBU TERPILIH DI MALAYISIA

ADAMU MUHAMMED TUKUR

Jun 2016

Pengerusi : Prorfesor Madya Shamsul Bahri HJ Mohd Tamrin, PhD
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Latar Belakang: Isu-isu kesihatan awam yang berkaitan dengan keselamatan daging masih menjadi isu utama dalam abad ke-21 yang memberi kesan kepada negara-negara maju dan negara-negara kurang maju. Beberapa wabak penyakit berkaitan makanan dikaitkan dengan *Escherichia coli*. Pernyataan Masalah: Peruntukan yang tidak mencukupi peralatan dan kesedaran mengenai keselamatan makanan adalah beberapa faktor yang mempercepatkan penyebaran *E.coli* kepada alam sekitar. Peningkatan kelaziman patogen *Escherichia coli* di kalangan populasi manusia boleh dimasukkan ke hospital dan juga kematian. Justifikasi: Kejadian keracunan makanan telah meningkat sejak sedekad yang lalu di Malaysia dan *E.coli* didapati punca utama. Campur tangan termasuk pendidikan kesihatan dan kesedaran yang memberi tumpuan kepada pengendali makanan boleh berkhidmat sebagai langkah proaktif dalam pengurusan dan pencegahan penyakit yang berpunca daripada pengambilan makanan tercemar. Oleh itu, objektif utama kajian ini memberi tumpuan kepada menilai kesan campur tangan dalam meningkatkan Pengetahuan, Sikap dan pekerja rumah penyembelihan Amalan (KAP) dan mengurangkan kelaziman *E.coli* dalam beberapa rumah penyembelihan dipilih. Metodologi: Program campur tangan dalam bentuk pekerjaan, makanan dan keselamatan alam sekitar telah dijalankan dalam kajian ini. Kesan campur tangan dinilai dalam dua fasa; fasa campur tangan sebelum dan selepas. Soal selidik dan koleksi sampel telah digunakan untuk penilaian KAP dan kelaziman *E.coli* masing- masing. Penemuan: Tiga puluh dua pekerja mengambil bahagian dalam penyelidikan. Skor min bagi pengetahuan, Sikap dan Amalan, sebelum campur tangan masing-masing 7.1 ± 1.87, 4.3 ± 0.73 dan 5.5 ± 1.01. Selepas campur tangan markah masing-masing 9.4 ± 2.15, 4.7 ± 0.48 dan 5.8 ± 0.93. perbandingan antara KAP skor dalam fasa sebelum dan selepas campur tangan, terdapat perbezaan yang signifikan dalam pengetahuan ($p = 0.000$) dan sikap (0.025) tetapi tiada perbezaan yang ketara diperhatikan dalam skor amalan ($p = 0.115$) berdasarkan keputusan. Pengurangan yang ketara ($p = 0.04$) dalam / ml cfu air sisa menunaikan semua rumah penyembelihan ke dalam persekitaran itu direkodkan. Kontaminasi bangkai juga didapati menurun dalam semua rumah penyembelihan ($p = 0.033$) selepas campur tangan. Sampel swab tangan yang dikumpul semasa kajian menunjukkan *E.coli* O157: H7 telah diasingkan di tangan pekerja semasa bekerja di dua lokasi dan jumlah kelaziman semasa kerja adalah 9.4%. Bukan O157: H7 adalah

34.5% dalam fasa pra-campur tangan. Di dalam jumlah kelaziman fasa pasca campur tangan semasa kerja didapati 0% untuk E.coli O157: H7 dan 27.8% untuk Non-O157: H7. Kesimpulan: Berdasarkan dapatan program campur tangan didapati mempunyai kesan ke arah meningkatkan pekerja KAP dan pengurangan *E.coli* kelaziman dalam Abattoir.

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This thesis submitted to the Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) were adhered to.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The public health issues related to meat safety remains a major issue in the 21st century which affects both the advanced and third-world countries. Several outbreaks of diseases linked with food in the United States and China were associated with infectious organisms including *E.coli* O157:H7 and other pathogens. Such public health issues have created a considerble meat safety problem to the forefront of public health concern (Bai *et al.*, 2015 and Sofos 2008). The pathogens are resistance to many powerful antimicrobials used for chemotheraphy (Anderson *et al*., 2015 and Badura *et al*., 2015) According to estimated figures, 10% of the European population suffers from diseases associated with food each year (Motarjemi & Käferstein 1999). Pathogenic *E. coli* known as Shiga toxin (Stx)-producing *E. coli* (STEC) are associated with various food products including ground beef. These pathogens are present in a wide range of environments, and have caused numerous foodborne outbreaks and recalls. These outbreaks and the increased awareness of STEC have led to certain STEC serotypes to be declared adulterants in non-intact raw meat (Baker *et al*., 2016). Cattle slaughtering and processing in the abattoir brings about environmental hazards; chemical, physical and biological hazards. *Salmonella, Listeria and E.coli* are the main biological hazards and bacterial pathogens encountered in the abattoir (Bolton 2001). *Escherichai coli* growth can be used to assessed or estimate microbiological safety of raw meat (Greer *et al.* 1994). The presence of *E.coli* have been used as indicator of meat contamination by cattle fecces and possible post-processing contamination of products (Doğan-Halkman *et al.* 2003).

An abattoir or slaughter house can be decribed as a place registered and approved by a regulatory agency or the supervisory authority for inspection and appropriate slaughtering of animals, processing and proper storage and preservation of meat and its products for public consumption (Alonge 1991). Abattoir waste can be detrimental to inhabitants of a particular location and their immediate environment if proper measures are not taken. The major environmental issues linked to abattoir are the large amount of suspended solid and liquid wastes and contamination of the environment with unwanted bacteria. These bacteria may not be necessarily pathogenic but those that produce odoriferous air pollutants (Chukwu 2008). The challenge faced by various countries worldwide is the ever increasing population which corresponds with increase demand for meat production to satisfy the protein needs of the public. Some environmental and public health burden may be attached to the expansion of slaughter houses (Laukova *et al*. 2002 and Hinton *et al*. 2000). Slaughter houses in most cases are apparently less equiped in economically low income countries compared to developed countries, where pollutant Impact Analysis to the environment and treatment of waste are generally taken into account before constructing the abattoir (Chukwu 2008). Consequently, deficiciences in technical-know-how and availability of protective and animal processing equipments in the underdeveloped countries in many situations results in food contaminations. These contaminations usually come

from hide removal and cattle evisceration (intestinal content) which may harmfully affect our natural environment in various ways including transmission of microrganisms into various ecosystems (Amisu *et al*. 2004).

Morbidity rate evolving from the ingestion of contaminated food items is among the most frequently reported public health conundrum in the recent times. Meat is food of course and undoubtedly classfied in the category. The illnesses associated with foods results in human distress and cause decrease in labor and productivity, which in most situations could lead to extensive economic deficit. The microbes identified as causative agent for infection and contamination of meat and its product have been found classified as yeasts, moulds as well as bacteria. Such microorganisms may be transferred form various sources into the meat by the abattoir workers, or via air in the environment, water during animal processing, cutting rooms or tables and even during cooling and preservation (Abdullahi *et al*., 2006).

Moreover, favourable environmental conditions for microbial growth in the tropical regions together and also inadequte water supply as well as lack of training for food handlers affects bacteriological quality of beef and its products to a very high exposure to pathogens. Consequently, this high level of contamination will give way for speedy spoilage and consequently emergence of diseases and outbreaks (Abdullahi *et al*., 2006). Micoorganisms such as *E.coli, Salmonella* spp and *Clostridium* spp among others are of public health interest worlwide because of their potential in meat spoilage and related products in addition to their significance in disease transmission through food consumption. Strains of these bacteria have also been frequently reported by reseachers to resist the effect of antimicrobials (Mayrhofer *et al*., 2004, McDemott *et al*., 2004, Nys *et al*., 2004 and Dahiru *et al*., 2008). *Escherichia coli* is one the species identified as normal of the animal intestine. However, presence of *E.coli* on cattle carcass is regared as an indication of microbial contamination due to contact between feces and carcass during animal processing. During processing, levels of *E.coli* can increase and may be influenced by some conditions like the hygienic practices in the abattoir, degree of contamination cattle before slaughter and type of the evisceration technique used. The importance of *E.coli* in disease transmission is of global significance which has been highlighted by researchers and the role played by the bacteria in food contamination may result in substantial economic burden (Bell 1997).

The genus *Escherichia coli* consists of facultative anaerobic bacteria (bacillus), Gram-negative, commonly isolated from the GIT of animal species. It is classified under the the Enterobacteriaceae family. They are non-fastidious microorganism, bile-tolerant, that can be easily grown on normal laboratory media. They grow best at moderate or mesophilic temperature (optimum is 37^0C) and usually ferment lactose**.** *Escherichia coli* O157:H7 also known as Enterohamorraghic *E.coli* also known as EHEC was highlighted and implicated in many cases of severe illness and mortality as well as diseases linked to several food items (Bell 2002). It was recognised in 1983 as the bacteria that caused an outbreak of Hemorrhagic Colitis in the US and said to produce a toxin similar to that of *Shigelle spp* called shiga toxin. After two years, the bacteria were epidemiologically associated with Heamolytic Uremic Syndrome (O'Brien *et al*.

2001) and (Karmali *et al*. 1985). The bacteria thrive as a non-pathogenic microorganism of the human microflora and other mamals.

Interventions in environmental health can affect a vast number of human population living in a particular workplace, settlement, Distric, country or the world population. Attached to it are some binding regulations that may affect personnel and financial resources and in some cases go against individual interest. Environmental health intervention can be defined as "any deliberate modifications to the natural or physical environment, or of behaviours related directly to them, which are undertaken with the intention to protect or improve health". Generally, the intervention programs are directed towards activities that initiate direct, related modifications in a particular technology or behaviour to those that result in indirect, more distal changes in policy. Several related components are combined together to achieved the intended aims of the intervention program (Rychetnik *et al*., 2004, WHO 2006, Eva and Jamie 2014). Hence, evaluation of interventions which involved complex interactive component will be very difficult to perfom especially data collection, data processing and conclusions. (Craig *et al*., 2008; Kelly *et al*., 2010; Lavis *et al*., 2004; Rychetnik *et al*., 2002; 3ie, 2011; Thomson et al., 2004). However, the new paradigm shift to a concept of evidence-based public health (EBPH) has denoted a comparatively new idea about the relevance of environmental health intervention program in preventive medicine. Under the concept, EBPH has been described as "the development, implementation and evaluation of effective programmes and policies in public health through application of principles of scientific reasoning, including systematic uses of data and information systems and appropriate use of behavioural science theory and program planning models" (Brownson *et al*., 2009). Certainly, the benefits of environmental health interventions may be gradual due to its preventive nature and sometimes takes quite a long time to be detected by statistical methods. Malaysia consumers as found in most developed countries are also becoming increasingly aware and concern on food safety issues. Based on available data only few investigations wer conducted on the prevalence of *E. coli* isolates from Malaysia. Apparently no intervention program was performed by researchers for improvement of knowledge, attitude and Practice among certified cattle abattoir workers. In addition, many researchers have linked the prevalence of *E.coli* in Malaysia to vegetables and meat but little is known about the sources of contamination of such food items. The number of cases and incidence of food and waterborne diseases in Malaysia are mainly associated with food poisoning as shown in Fig.1.1 below.

Year	Food Poisoning		Typhoid		Cholera		Dysentery		Hepatitis A	
	Case	IR	Case	IR	Case	IR	Case	IR	Case	IR
2000	8129	34.9	765	3.3	124	0.5	447	1.9	-	-
2001	7137	30.7	695	3.0	557	2.4	384	1.5	453	1.9
2002	7023	28.6	853	3.5	365	1.5	292	1.2	295	11.0
2003	6624	25.4	785	3.0	135	0.5	310	1.2	-	-
2004	5957	23.3	484	1.9	89	0.4	356	1.4	107	0.4
2005	4641	17.8	1072	4.1	386	1.5	141	0.5	44	0.2
2006	6938	26.0	204	0.8	237	0.9	105	0.4	64	0.2
2007	14,455	53.2	325	1.2	133	0.5	146	0.5	94	0.4
2008	17,332	62.5	201	0.7	93	0.3	92	0.3	36	0.1
2009	10,238	36.2	303	1.1	276	1.0	154	0.5	40	0.1

Figure 1.1 Number of cases and Incidence Rate of Food and Waterborne diseases, Malaysia, 2000-2009 (Sharifat *et al*., 2013)

1.2 Problem Statement

Improper procedure of food processing in industries linked to workers negligience has been reported as a major causes of diseases outbreaks resulting from consumtion of contaminated food. In Malaysia, the reported prevelance of *E.coli* ranged from 22.6-88%. The incidence of caused by the O157:H7 strain was reported as 28.6% for Southern, 38.8% for the Central, 36.5% for the Eastern and 35.6% for the Northern region (Chye *et al*., 2004). Pathogenic organisms can pollute the natural waters and through consumption of such polluted waters or eating raw vegetables contaminated through irrigation or running waters, different forms of diseases may emerge. Also several organisms can be transferred from the polluted abattoir environment to the bovine carcasses by butchers during evisceration or meat processing.

1.3 Justification

An intervention program for Halal abattoir workers can serve as a strategic way through which food and occupational safety can be improved. It can provide long-term benefits for the Halal food industry. The intervention program in form of education and awareness on topical issues such as occupational safety for personnel protection, food safety for public protection and environmental heath for environmental safety is the first proactive measure that can be applied to manage or prevent food borne outbreaks and illnesess. In addition, cross transmission of pathogens from the abattoir environment to bovine carcasses or from intestinal content of slaughtered animals to bovine carcasses is of paramount importance because this could lead to dissemination of food borne pathogens to the consumers. There is a need for research to be conducted in Malaysia to educate abattoir workers and determine the sources of contamination of beef meat by *E.coli* so that level of contamination can be reduce to the barest minimum. Some of the studies conducted in Malaysia have highlighted lack of basic education on food handling and microbilogical safety as some of the factors that accelerate food and waterbornes diseases outbreak. Abattoir effluent has an adverse impact on public health, farming, portable water and ecology of plant and animal diversity in the aquatic environment. To some extent, it has become a major problem

for many urban settlements. An increase in the prevalence of pathogenic bacteria like *E.coli* O157:H7 may result in high level of hospitalization and deaths. To this end, there is a need for an intervention which focus on methods that can help to reduce the occurance rate of the O157:H7 strain in cattles before it enters the food chain. This can serve as proactive measure and have an enormous potential to decrease morbidity and mortality among the human population. Hence there is a need to know the prevalence of these pathogens associated with abattoir waste water because the ability to decrease human and economic expense of the disease relies not only upon the diagnosis and effective cure for human hosts, but additionally upon the application of protective and preventive measures that halt the transmission cycle.

1.4 Conceptual Frame Work

The study has identified several related factors that the lead to environmental and public health problems emanatiying from the abattoirs. Some of the prominent problems include; Waste water discharge, lack of sanitation and mishandling of Cattle carcass. The factors are highlighted in Fig.1.2

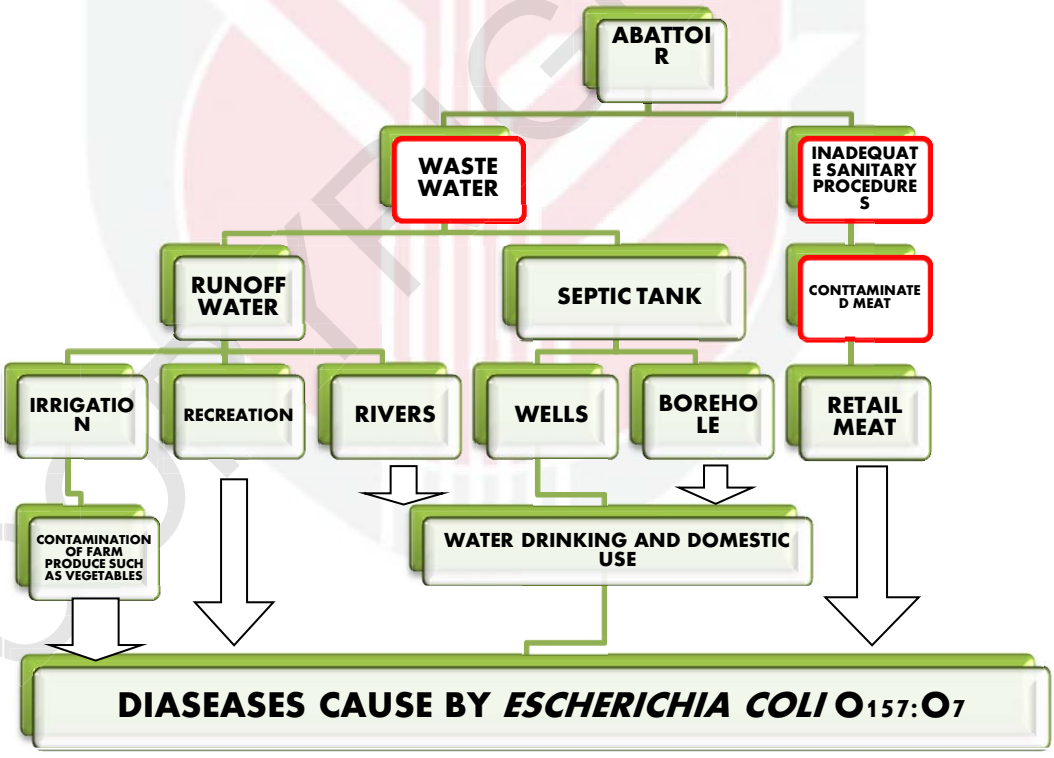

Figure 1.2 Relationship betweeen abattoir practices and Environmetal Health

The study also suggests the possible solution to the environmental problems caused by the abattoir industry base don route of transmission of the bacteria as shown below in Fig.1.3

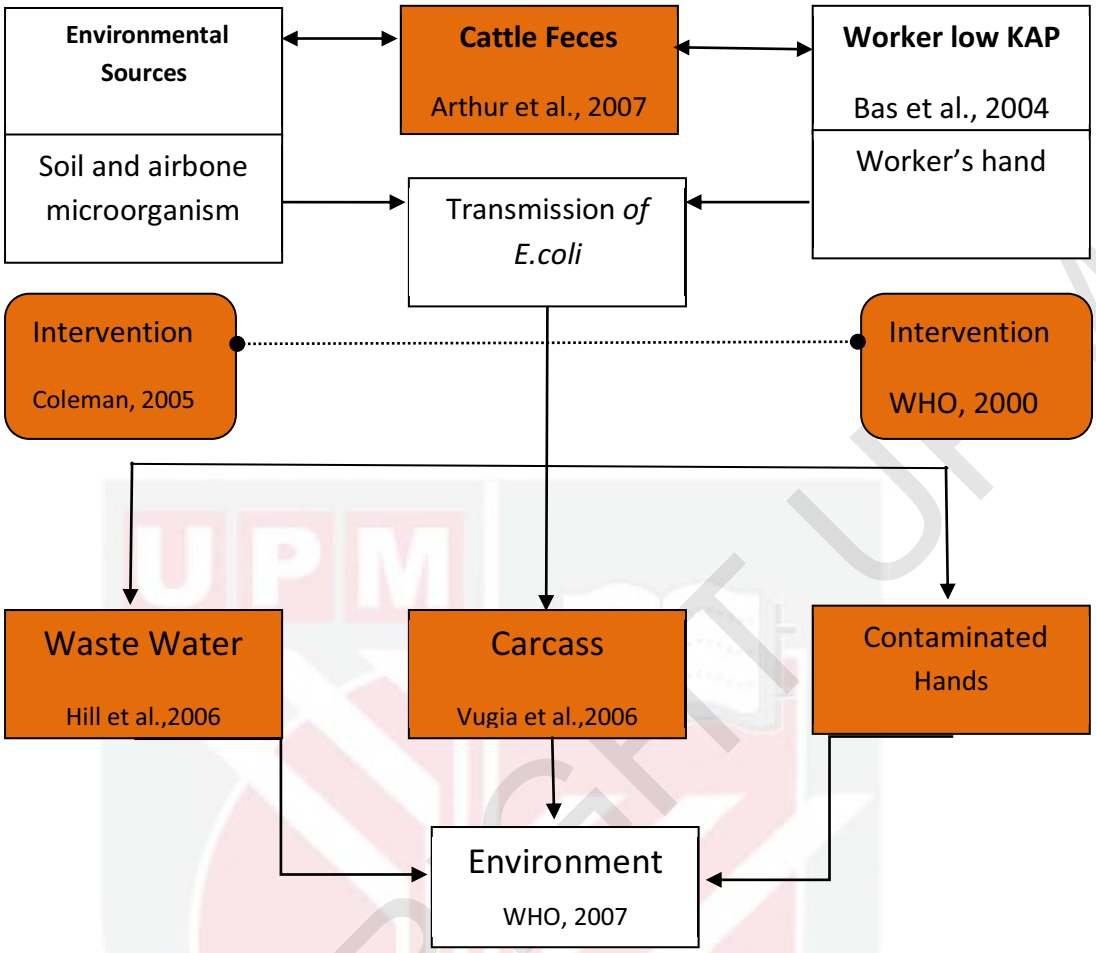

Figure 1.3. How an intervention program can reduce environmental hazards pose by abattoirs.

1.5 Objective

1.5.1 General Objective

The aim of this research work is to determine the impact of intervention program on Knowledge, Attitude and Practices of workers and *E.coli* serotypes in Malaysian Cattltle abattoirs.

1.5.2 Specific Objectives

- To determine the dermography and compare the KAP score of cattle abattoir workers before and after intervention
- To compare provisions of safety equipments to workers before and after the intervention.

- To compare the total coliform count of waste water discharged by abattoirs after discharge into the environment in pre and post intervention phases.
- To compare the prevalence of two *E.coli* serotypes (O157:H7 and non-O157:H7) in abattoir waste water before and after discharged.
- To compare the prevalence of two *E.coli* serotypes on cattle carcass before and after intervention
- To compare prevalence of *E.coli* serotypes on hands of abattoir workers before, during and after work during pre-post intervention phases.

1.6 Hypothesis

Null Hypothesis (H_0)

1. There is no significant difference in KAP score among cattle abattoir workers before and after intervention.
2. There is no difference in provisions of safety equipments and training before and after intervention.
3. Threre is no significant difference in total coliform counts abattoir waste water before and after discharge into the environment in pre and post intervention phases
4. There is no significant difference in prevalence of *E.coli* O157:H7 and non-O157:H7 on cattle carcasses before and after intervention.
5. There is no significant difference in prevalence of *E.coli* O157:H7 and non-O157:H7 on hands of abattoir workers before, after and during work in pre-post intervention phases.

1.7 Definition of Variables

1.7.1 Conceptual Definition

1.7.1.1 Cattle Feces

Waste matter discharged from animal digestive tract after food has been digested. It is the major source of *E.coli* and related pathogens in abattoirs (Campbell, 1996).

1.7.1.2 Intervention

Intervention can be defined as "any deliberate modifications to the natural or physical environment, or of behaviours related directly to them, which are undertaken with the intention to protect or improve health". Inteventions can be used as a first line of defence against spread of *E.coli* to cattle carcass and the public by blocking the transmission route (Eva and Jamie, 2014)

1.7.1.3 Waste Water

Water used for the cleaning up of slaughtered animal carcasses, floor of abattoir, walls and contact surfaces, personnel and slaughter equipments. Abatoir effluent composed of large concentration of animal blood and solid particles from the gastrointestinal contents of animals. Presence of *E.coli* in waste water can contaminate water souces especially in rural areas and also vegetables when used for irrigation (Adeyemo *et al*., 2002)

1.7.1.4 Carcass

Body of animal slaughtered purposefully for human consumption. Cattle carcass can be contaminated during slaughtering and other processes in the abattoir. Presence of *E.coli* especially the O157:H7 serotype is not acceptable by regulatory agencies (USDA).

1.7.1.5 Contaminated Hands

Workers hand is said to be contaminated when it harbors pathogenic microorganism. These microorganisms are transmissible to another animal during work or to other person. Contamination arise from contacts with animal parts or contact surfaces.

1.7.2 Operational Definition

1.7.2.1 Cattle feces

Prevalence of *E.coli* was determined using selective media specifically meant for its isolation and identification. Confirmation for the bacteria was conducted using prepared antibodies for detection of the two antigenic structures of *E.coli* O157:H7.

1.7.2.2 Intervention

Impact of the intervention program was evaluated through data collection using questionnaires in case of KAP and sample collection for prevalence of *E.coli* before and after intervention. The Knowledge, Attitude and Practice wwere measured by calculating the score of each respondent.

1.7.2.3 Waste Water

The prevalence of *E.coli* in waste water was determined by detection of the bacteria through microbiological procedures; cultural, biochemical and serological tests. In addition, CFU/ml of the waste water was determined using filter membrane techniques.

1.7.2.4 Contamination of Hands

Prevalence of *E.coli* on hands of abattoir workers was determined by hands swabs sample collection. The hands swab samples were subjected to microbiological analysis using selective and differential meadia for identification.

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Adamu Muhammad T., Shamsul Bahri M. Tamrin, Desa Mohd N., Khairani-Bejo S. and Irwan Syah MDY (2015): Assessment of Exposure to *Escherichia coli* among Halal Cattle Abattaoir Workers in Malayssia. *Journal of Advances in Environmental Biology*, 9(24): 204-211.

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