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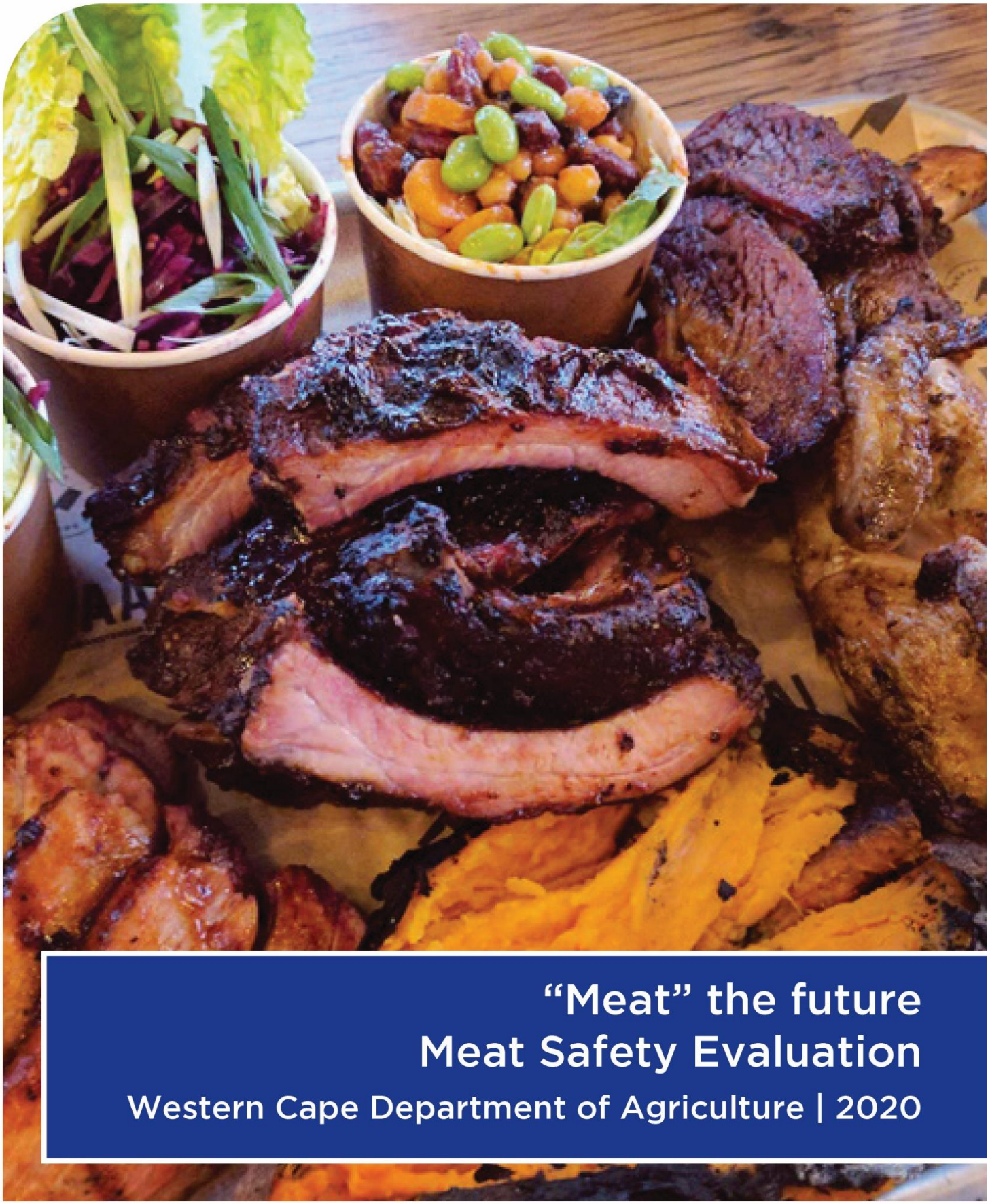


"Meat" the future
Meat Safety Evaluation

Western Cape Department of Agriculture | 2020

Contents

Key Policy Implications

- In interviews, there was concern raised that abattoirs are finding it costly to make the regulated changes that are presented to them as corrective action. Further, many abattoirs claim that they cannot afford the correct number of Meat Inspectors. Thus, a subsidy could alleviate the financial pressure on individual abattoirs. This subsidy could be given to abattoirs that fall within specific Hygiene Assessment System (HAS) boundaries for a limited period to facilitate adherence to regulations.
- One Veterinary Public Health Officer stated, "(Registrations is a) barrier to entry, people consult, but never get beyond contact session". Therefore, a recommendation would be for the Department of Agriculture to work collaboratively with smaller abattoirs to mitigate these barriers. Any lessons learned that make it easier for smaller abattoirs to comply with regulations would also have a positive effect on those abattoirs calling for financial assistance.
- There is considerable uncertainty about the regulations and their relationship with HAS scores. Some abattoirs do not understand why their scores remain the same (or are reduced) after they complete corrective actions. The department should attempt to create operational definitions for different levels of performance on the HAS.
- It is recommended that the Department creates a "Continuous Professional Development" programme (similar to those required by the Health Professions Council of South Africa) for Veterinary Public Health Officers.
- Employ Meat Inspectors through the Government to reduce cost of employment for smaller abattoirs, and properly support objectivity and prevent conflicts of interest.
- Monitor Training and Development to enhance abattoir employees' understanding of requirements. Training and development can assist both the employee and organisation to close skill gaps, through providing the relevant knowledge, skills and abilities to fulfil their job roles, as well as support compliance with regulations.
- It is recommended that the Department consider utilising the hazards and indicators identified by the European Food Safety Authority to improve the identification and monitoring of common biological hazards from farm to abattoir in the Western Cape. These HEIs were designed to assist with hazard monitoring in EU countries, regions, abattoirs, and farms. However, these indicators could be used to equally good effect in South Africa too.
- It is recommended that the Department consider the adoption of a new auditing tool to replace the HAS system, which is currently in use. The tool under recommendation is the Hygiene Performance Rating system which was developed by Animalia (Norway). It is the position of Alacrity Development, that the design and structure of the HPR tool is of a high quality, and superior to the HAS, which is currently in use by the Department.
- It is recommended that the Department integrate a Hazard Analysis and Critical Control Point (HACCP)-based hazard analysis approach into the Hygiene Management System (HMS). This is to ensure that a common and internationally-recognised method is being employed by all abattoirs, to help improve the identification of facility-specific hazards in abattoirs, and to make the fundamentals of hazards analysis more explicit and detailed in the regulations.
- It is recommended that the Department consider incentivising farmers to encourage the adoption of better biosecurity measures/practices at the farm level.

Executive Summary

Abattoir Hygiene Assessment performance has improved steadily over the last 10 years, particularly in low throughput and rural abattoirs that serve some of the most disadvantaged and rural communities. However, there is still much that can be done to improve how abattoirs (and the department), engage with meat safety.

Background

For centuries, zoonotic diseases have taken a serious toll on human health, and still contribute significantly to the global burden of disease. A zoonotic disease is an infectious disease caused by a pathogen (such as a bacterium, parasite, or virus) that has jumped from an animal, typically a vertebrate, to a human. Out of a total of 1415 species of pathogens which affect humans, 868 (61%) can be classified as zoonotic (Christou, 2011). Foodborne transmission is one of the most common modes of transmission for zoonotic diseases. The passing of South Africa's Meat Safety Act in 2000 acknowledged the need for tighter monitoring and evaluation systems in the sector, and the department has introduced a number of interventions based on this legislation, designed to improve meat safety in the province. These interventions are: Abattoir Registrations; Abattoir Inspections; Abattoir Hygiene Assessments; and the Meat Inspection Services. At present, the Western Cape has a total of 68 abattoir facilities registered within the Province and regulated under the Meat Safety Act. The meat industry, specifically in the Western Cape, covers a wide range of animal species such as beef, sheep, pork, chicken, duck, rabbit, ostrich, and game. Properly constructed and implemented meat safety legislation is at the heart of an international effort to ensure that high-risk sectors, like abattoirs, produce safe meat.

Therefore, the purpose of this evaluation was to determine the following:

a) The extent to which the Department's legislative meat safety responsibilities are met;
b) The effectiveness of the intervention in ensuring that meat products that get to market are compliant with regulatory requirements towards meeting meat safety standards; thereby ensuring safe meat to consumers and preventing the transfer of zoonotic diseases to humans;
c) Challenges associated with implementing meat safety assessment requirements.

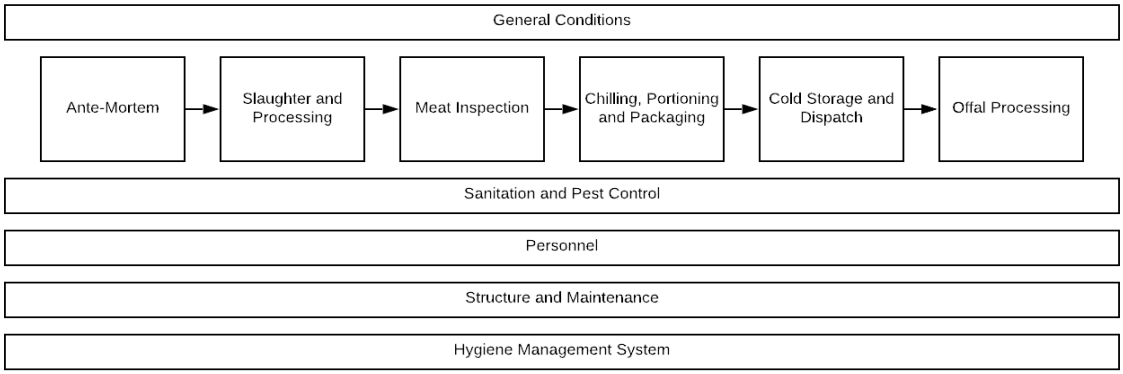
In addition, the following approaches and evaluation questions were used:

Evaluation Approach	Evaluation Question
Contextual Review	What is the type and extent of the direct and indirect quantifiable health benefits which individuals and society reap from the meat safety inspection service?
	What quantifiable socio-economic benefits resulted from these interventions?
Design Evaluation	What attitudes are there regarding regulation of animal slaughter and meat processing in these environments?
	What changes, within the power of the Province, could be made to the current system (including independent meat inspection and ante-mortem inspections) to ensure safer meat in a more cost-efficient way?
Impact Evaluation	How effective have compliance monitoring inspections been in improving the level of meat safety and Hygiene Assessment System (HAS) ratings of individual abattoirs?

A Sample of 16 Western Cape abattoirs, representing a wide variety of contexts, was used in this study. We relied primarily on Hygiene Assessment data, interview data, and literature to answer these questions. We used a combination of statistical modelling and content analysis to examine patterns and draw conclusions.

How did abattoirs improve, and what does this mean for community health, and economic wellbeing?

Each abattoir is responsible for their hygiene management systems, which they are required to establish through the guidance of regulations contained within the Meat Safety Act of 2000. In addition, these regulations require that abattoirs establish control points to lower the risk of biological, chemical, and physical hazards being introduced into the food supply chain. These "control points" are represented as the HAS categories presented in the figure below.



As each of these categories represents a different area of meat safety, enhancement of performance in these categories should result in lower risk of contamination. Some of these categories represent opportunities for direct contamination of the product (due to their relationship with the production line), particularly the area of the figure linking Ante-Mortem to Offal Processing. Other categories have an indirect effect, by either influencing the environment around the production line, or determining how personnel behave around the product. Increasing HAS scores across all categories helps prevent the contamination and spoilage of meat while it is being processed in the abattoirs, and lowers the risk of microbiological, chemical, and physical hazards making their way to the consumer, causing illness.

It is encouraging to note that average HAS scores across abattoirs in this sample have increased steadily since 2010. On average, abattoirs perform above the "Bronze" rating across HAS categories (the 60 point level and the minimum level necessary to receive a rating), and are approaching the silver level (a score of 80). Low Throughput abattoir performance was particularly impressive. In the first 3 years of our sample (2010, 2011, and 2012), 64% of HAS category ratings performed too poorly to receive a rating and were therefore below the minimum standard. This "No Rating" status decreased to 23% of HAS category ratings in the last 3 years of our sample (2016, 2017, and 2018) – an improvement of 41%. Silver or greater ratings have also improved from 6% to 16% of HAS category ratings in our sample. Raising HAS category scores in low throughput abattoirs is vital for safeguarding the health of vulnerable populations in South Africa, as many of these abattoirs are situated in rural areas and serve the rural populations. In addition, these abattoirs are an important employer, and provide financial security in these areas too. Trust in the meat produced by these abattoirs is vital, both for the food security of the community, and for the economic wellbeing of the abattoir itself. Beyond this more localised economic benefit, improving HAS scores through effective Abattoir inspections helps promote a strong economy. This happens by preventing the considerable economic costs which can arise because of meat-borne illness. The death and sickness which can result from contaminated meat can, in turn, cause substantial economic loss to the individual and the economy.

What barriers are there to further improving the safety of meat, and what can be done to improve further?

Interviewees noted that the impact of regulations on profit was common problem. Structural Regulations were mentioned as particularly challenging, followed by the cost of Meat Inspectors. Compounding this problem further, was the scarcity of suitably qualified Meat Inspectors, and an overwhelming need for on the job training. Finally, the general commitment (or willingness) of abattoir employees to meat safety was identified as lacking. Other issues included mentioned included lack of access to waste management facilities or biological testing labs, and a weak supply of animal stock for slaughter. We recommend the following: Provision of a subsidy to alleviate the financial pressure on struggling abattoirs; Financially support Environmental Impact Assessments to remove this as a barrier to entry for smaller abattoirs currently slaughtering illegally. Employ Meat Inspectors through the Government to properly support objectivity and prevent conflicts of interest; Monitor Training and Development to enhance abattoir employees' understanding of requirements. Create operational definitions for different levels of performance on the HAS, to enhance score transparency and reliability. Provide training and support to Veterinary Public Health Officers to support regular visits, collection of samples, and provision of the expected quantity of support to abattoirs.

Presently, abattoirs are not required to conduct facility-specific hazard analysis and rank hazards based on severity and risk using a predetermined method. This increases the health risk to the consumer, as it is possible that hazards which are unique to individual facilities will go unidentified. Therefore, it is recommended that the Department integrate an HACCP-based hazard analysis approach into the HMS to improve hazard identification in individual abattoirs (Govender, 2016). Requiring abattoirs to conduct their own hazard analysis will help abattoir owners and hygiene management teams to acquire a more detailed knowledge of the relevant microbiological, chemical, and physical hazards, as well as the level of risk that they pose the consumer. In addition, It is recommended that the Department consider utilising the hazards and indicators identified by the EFSA to improve the identification and monitoring of common biological hazards from farm to abattoir (European Food Safety Authority Panel on Biological Hazards - EFSA BIOHAZ Panel, 2013). These reports rank biological hazards based on the assessment of: (1) the magnitude of the human health impact based on data on reported incidence, (2) the severity of the disease in humans based on the number of fatalities among reported cases, and (3) the weight of evidence that meat from specific animals is an important risk factor for disease in humans (EFSA BIOHAZ Panel, 2013). These first two recommendations would be supported by the adoption of a new auditing tool to replace the HAS system, which is currently in use. The HPR system is the only system with evidence supporting an association between its results and bacteria levels detected on carcasses. The HPR offers an extremely detailed approach to auditing slaughter hygiene in abattoirs. Unlike the HAS, the HPR has firm operational definitions for indicators and levels of performance which should be repeatable. This means that criteria supporting the awarding of particular scores are explicit and transparent, and abattoirs will be able to better use the results of the tool to improve their performance. Finally, it is recommended that the Department consider providing incentives to farmers to adopt biosecurity measures, which will assist with reducing or eliminating hazards while on the farms. The body of research suggest that control measures placed at the farm level can be a useful means of reducing the prevalence of infections in livestock.

Meat Safety Evaluation

Context

For centuries, zoonotic diseases have taken a serious toll on human health, and still contribute significantly to the global burden of disease. A zoonotic disease is an infectious disease caused by a pathogen (such as a bacterium, parasite, or virus) that has jumped from an animal, typically a vertebrate, to a human. Out of a total of 1415 species of pathogens which affect humans, 868 (61%) can be classified as zoonotic (Christou, 2011). Only infections which come from vertebrate animal hosts either through direct, foodborne, or intermediary vector-borne transmission can receive this classification. However, many zoonotic pathogens are not zoonotic in practice – the H1N1 influenza strain serves as a good example. While the H5N1 strain remains reliant on its avian host for transmission to humans, the H1N1 virus has adopted an anthropocentric (human) life cycle. This means that H1N1 no longer needs a non-human animal host to spread. After H1N1 moves from its avian host to a human host, it continues to spread among humans. This is what allowed the H1N1 pandemic in 2009 to take place (Christou, 2011).

Historically, few cases better demonstrate the potential threat of zoonotic disease for society than the Spanish flu (H1N1) pandemic of 1918. Over the course of 12 months the virus infected roughly one third of the planet's population, and killed an estimated 20 to 50 million people (Taubenberger, 2006). In the eyes of some historians, epidemic zoonoses have not only been behind the deadliest epidemics in human history, but have changed the course of history and reshaped human society. In Cape Town alone, the outbreak of bubonic plague in 1901 has been credited with the advancement of segregationist policy and ideology, culminating in the establishment of Ndabeni Township (Swanson, 1977). More recently, COVID-19 (also a zoonotic disease) has changed how billions of people travel, work, communicate, and live.

Foodborne transmission is one of the most common modes of transmission for zoonotic diseases. The threat posed by bovine tuberculosis has been recognised since the 1950s, transmitted mainly through the ingestion of infected milk (Department of Agriculture, 1999). However, nearly all animal products made for human consumption can transmit zoonotic disease under the right conditions. Many parasites remain endemic in societies where the consumption of raw or partially cooked food remains a well-established practice (Macpherson, 2005). Over the last decade some populations have suffered a rise in the incidence of parasitic zoonoses, due to an increasing tendency towards eating animal products which have not been properly cooked. The consumption of unregulated or illegally slaughtered meat also carriers a considerable health risk, as contamination of the carcass before, during, or after slaughter is highly likely if hygienic slaughter practices are not followed. This can and has been addressed through the construction of relevant legislation. Properly constructed and implemented meat safety legislation is at the heart of an international effort to ensure that high-risk industries, like abattoirs, process livestock and carcasses as safely as possible. The passing of South Africa's Meat Safety Act in 2000 acknowledged the need for tighter monitoring and evaluation systems in the sector.

At present, the Western Cape has a total of 68 abattoir facilities registered within the Province and regulated under the Meat Safety Act of 2000. The meat industry, specifically in the Western Cape, covers a wide range of animal species such as beef, sheep, pork, chicken, duck, rabbit, ostrich, and game. The Western Cape Department of Agriculture has since introduced a number of interventions to help improve meat safety.

Interventions

Abattoir Registration

The Western Cape Department of Agriculture (WCDOA) requires that all abattoirs in the Western Cape meet specific regulatory requirements in order to gain or renew registration each year. The purpose of this process is to ensure that all abattoirs continue to meet regulatory requirements or risk losing their registration and their permission to operate along with it. The degree of regulatory compliance in abattoirs is assessed and documented during abattoir inspections, which is described in the following paragraph.

Abattoir Inspections

The purpose of abattoir inspections, or audits, is to assess how effectively abattoirs are meeting regulatory requirements. This involves the assessment of factors which are deemed to have an impact on overall meat safety, and therefore, may pose a threat to the consumer. Upon completion of an inspection, abattoirs are provided with feedback and instructed as to which areas of their operation require improvement. If an abattoir fails to make improvements or redress regulatory infringements, this could result in the loss of registration.

Abattoir Hygiene Assessments

Abattoir Hygiene Assessments are performed using the Hygiene Assessment System (HAS), which is a tool designed to measure the regulatory compliance of abattoirs. Each HAS audit concludes with the award of the score which represents how well the abattoir has performed during that audit. All abattoirs which take part in the National Abattoir Rating Scheme (NARS) must be audited on a quarterly basis. This allows for constant compliance monitoring and increases the likelihood that abattoirs will be able/willing to comply with meat safety regulations. Each abattoir is responsible for the constant management and monitoring of their hygiene management systems, which they are required to establish through the guidance of the national regulations. Along with the audits, the HAS serves to scrutinise the implementation of the HMS. The National Abattoir Rating Scheme (NARS) complements the HAS scores by assigning each abattoir with a grading depending on their HAS score. The ratings of abattoirs can be requested by potential clients, thus making the abattoir more accountable to retailers and consumers. The purpose of this is to further incentivise abattoirs to comply with meat safety regulations, as a low HAS score may have a direct effect on the abattoirs business.

Meat Inspection Services

The purpose of meat inspection services is to monitor the meat inspection process. This includes the recruitment and use of independent meat inspectors and is required by meat safety regulations. All animals entering an abattoir must be inspected before (ante-mortem) and after slaughter (post-mortem). Post-mortem meat inspection is also called primary meat inspection. The purpose of primary meat inspection is to determine the suitability of the carcass for consumption and must be carried out by a meat inspector. A carcass can be given the rating of 'approved', 'conditionally approved', 'partial condemnation', or 'total condemnation'. If a carcass is not passed after the primary meat inspection, then secondary meat inspection takes place. Secondary inspection is conducted by a Veterinarian. Meat inspections ensure all livestock entering and all carcasses processed in a slaughter facility do not pose a threat to public health.

These four interventions and their effects can be represented as part of a Theory of Change. There are many tools for representing programme theory, but none are universally favoured,

so we will use a tool that we have found useful in our own work. This is the Programme Impact Theory.

Programme Impact Theory

A Programme Impact Theory describes the cause-and-effect sequence in which programme activities are the instigating causes, and social benefits are the effects produced. In this case, the immediate effects are captured nicely within the HAS (Rossi, Lipsey, & Freeman, 2004). We use these to populate the Programme Impact Theory presented below.

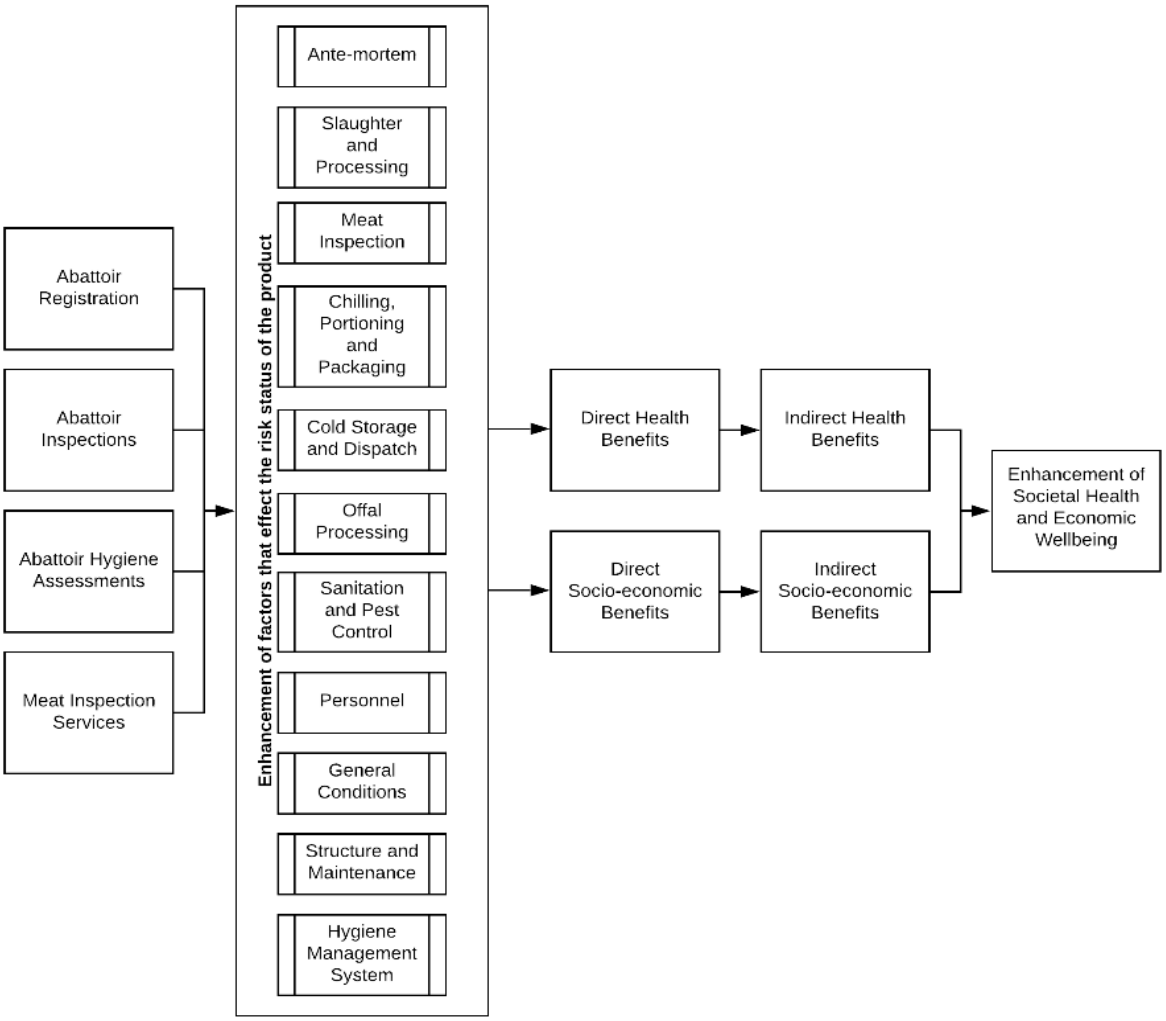


Figure 1: Programme Impact Theory

In addition to this tool, we find it useful to outline the sequence of outcomes and how they impact product as it proceeds through the abattoir. This is presented below in the results section on page 11.

Purpose / Scope of Evaluation

The original purpose of the evaluation was to determine/identify: the extent to which the Department's legislative meat safety responsibilities are met; the effectiveness of the intervention(s) in ensuring that meat products that get to market are compliant with regulatory; and challenges associated with implementing meat safety assessment requirements.

It was agreed between the WCDOA and the Evaluators (Alacrity Development), that the evaluation should answer the following questions:

1. How effective have compliance monitoring inspections been in improving the level of meat safety and Hygiene Assessment System (HAS) ratings of individual abattoirs?
2. What is the type and extent of the direct and indirect quantifiable health benefits which individuals and society reap from the meat safety inspection service (abattoir inspections as conducted by the department)?
3. What quantifiable socio-economic benefits resulted from these interventions?
4. What attitudes are there regarding regulation of animal slaughter and meat processing in these environments?
5. What changes, within the power of the Province, could be made to the current system (including independent meat inspection and ante-mortem inspections) to ensure safer meat in a more cost-efficient way?

Approach

In this section we outline the three broad approaches of the evaluation. These are the:

1. Contextual Review;
2. Design Evaluation; and
3. Impact Evaluation.

Contextual Review

The Contextual Review serves to provide important information on the context of animal slaughter in the Western Cape Province. The context covered by the review is both descriptive and predictive in nature. This means that it both describes the nature of controlled animal slaughter and associated requirements and practices, and explores the nature of zoonotic disease - and the long-term outcome of successfully controlling it via the enforcement of meat-safety interventions.

Design Evaluation

Design evaluation is described by the Department for Programme Monitoring and Evaluation (DPME) as a means of analysing the theory of change, inner logic, and consistency of an intervention (DPME, 2014). As noted previously, this type of evaluation should be done before an intervention is implemented, but in this evaluation, it is done as a means of improving programme implementation. Other evaluation frameworks, such as Rossi et al.'s (2004)

systematic approach to evaluation, divide the activities within a Design Evaluation into an evaluation of intervention Design & Theory, and intervention Process & Implementation.

Impact Evaluation

An impact evaluation serves to make a summary judgement of the effectiveness of an intervention (often expressed in terms of outcomes). Outcomes are the proximal effects of intervention activities, and these are expressed in the Programme Impact Theory, and the associated flowchart.

Method

The table on the next page shows the evaluation approaches, their evaluation questions, and their associated data sources. This section will go into greater detail on which data sources are used to answer each question and why (a further expanded method section with a more detailed treatment of the method is provided from page 16 to page 29 of Appendix E).

Contextual Review

The questions in this section are very difficult to answer within an evaluation using direct data analysis, as this data (both economic and public health) is often very difficult to acquire and even more challenging to collate and analyse to answer industry-specific questions in a cost-effective manner. Rather, this type of data is analysed routinely and published over time by organisations dedicated to this purpose. The Food and Agriculture Organisation under the United Nations contributes to this work, and a multitude of university departments also make their own contributions over time.

We conducted a type of review, called a Rapid Evidence Assessment. This approach has been used successfully as a means of gathering comprehensive evidence, useful for policy makers, in a cost-efficient way. This evidence can be gathered in as little as two months, while maintaining much of the rigour found in larger systematic reviews (Ganann, Ciliska, & Thomas, 2010; Tricco et al., 2015).

Evaluation Approach	Evaluation Question	Data Source(s)
Contextual Review	What is the type and extent of the direct and indirect quantifiable health benefits which individuals and society reap from the meat safety inspection service?	Rapid Evidence Assessment
	What quantifiable socio-economic benefits resulted from these interventions?	
Design Evaluation	What attitudes are there regarding regulation of animal slaughter and meat processing in these environments?	Structured Interviews
	What changes, within the power of the Province, could be made to the current system (including independent meat inspection and ante-mortem inspections) to ensure safer meat in a more cost-efficient way?	Rapid Evidence Assessment (and learnings from other evaluation questions)
Impact Evaluation	How effective have compliance monitoring inspections been in improving the level of meat safety and Hygiene Assessment System (HAS) ratings of individual abattoirs?	HAS/NARS Data

Table 1: Evaluation Approach, Question and Data Source

It is suggested that a Rapid Evidence Assessment be used when:

1. The questions are focused or constrained;

2. The questions are able to be 'mapped' easily to existing research; and

3. There are established methods for the assessment and the amalgamation of existing research.

A list of databases and search terms used by the review team can be found on page 18 of the technical Appendix E.

Design and Impact Evaluations

The Design and Impact Evaluations took a mixed method approach.

Mixed method approaches integrate Qualitative and Quantitative methods to answer questions that would be inadequately addressed by only one of these methods. We integrate the quantitative analysis of HAS/NARS data, with data collected during interviews conducted with a range of stakeholders. This allows us to both draw conclusions about the effectiveness of departmental interventions and explain their likely causes. In addition, the knowledge gained during the Contextual Review is used to understand and critically assess any results produced during HAS/NARS analysis or interview. However, this method is not without its requirements. As we are required to use multiple methods of data collection and analysis, and then integrate them, we must gather all data from the same parties. Thus, a single sampling frame is used for both HAS/NARS data collection, and for interview.

Sampling

Selection of Abattoirs for Interviews and HAS Analysis

Purposive sampling is used for identifying and selecting information-rich cases in accordance with predetermined criterion (Patton, 2002). This approach is preferable when the researcher(s) do(es) not have access to the entire population (in this case due to the cost that would incur). We started this process with a total population of 74 registered (or previously registered) abattoirs in the Western Cape (at the time of study design). We were instructed by the department to select no more than 16 abattoirs for inclusion in the study. In making this selection, all abattoirs in the Western Cape were stratified by geographic location (West Coast and East Coast), throughput category (High, Low and Rural), average daily output, meat type (Pork, Poultry, Cattle, Ostrich, Sheep, Pigs, Game and Rabbits), and whether the abattoir was subject to South African meat safety regulations, or European Food Law.

Purposive sampling requires that the sample of abattoirs be especially knowledgeable about, or be experienced in, an area. In the present case, that area would be the conditions that accompany the combination of factors represented by the sample criteria. This sampling method enabled the researchers to collate a lot of information with limited resources.

The sample had to include important high throughput abattoirs responsible for catering to large urban populations like the City of Cape Town or George, while also being representative of the full range of High, Low, and Rural throughput abattoirs spread throughout the province.

Selecting abattoirs based on average daily output was an important part of the sampling, as meat safety and hygiene standards may be more easily compromised in abattoirs with larger slaughter quotas, larger workforces, and more equipment and workspaces to clean and maintain (or perhaps it may be just the opposite). To properly account for the large range in average daily output in each throughput category and between meat types, the individual distributions of all meat and poultry abattoirs were split into either two or three output subgroupings depending on the requirements of the evaluation and what the sample size could accommodate. For the high throughput red meat abattoirs, one abattoir was selected from the top two of the three output bands created within the sampling frame. Two abattoirs

were selected from the bottom output band, as this met important geographical and logistical imperatives of the project. These imperatives being the location of the abattoir, and the finances available to conduct field work. We imagined two legs of abattoir visits over two weeks. We wanted it to be possible to visit all abattoirs over a two-week period. Eventually, it was decided to conduct some abattoir interviews telephonically, but this structure remained to facilitate abattoir visits where required. The three output bands contained the top, middle and the bottom producing 33% of the HT meat abattoirs in the Western Cape.

Two high throughput poultry abattoirs were selected from the top 50% of the output distribution, while one was selected from the bottom 50% of the output distribution. Two output subgroupings instead of three were chosen as the imperatives of the evaluation makes the inclusion of the two highest producing poultry abattoirs more vital. Two output subgroupings (top 50% / bottom 50%) were created for low throughput meat abattoirs and three output subgroupings (top 33% / middle 33% / bottom 33%) were created for low throughput poultry abattoirs in the sampling frame. The selection of the non-EU abattoirs also accounted for geographical location in order to ensure that the sample included abattoirs in different regions and municipalities in the Western Cape.

All abattoirs approved to export meat products to the European Union were included in the sample. These are all high throughput abattoirs and specialise in the slaughter of ostrich for international and local consumption. The average 'EU abattoir' is required to meet the strict meat safety standards set by the European Union. Therefore, these abattoirs are of the highest standard in terms of meat safety, hygiene, and animal welfare in the country. These abattoirs form an important benchmark for this evaluation, as they represent both an international standard or perhaps a best-case scenario for a South African abattoir.

Within each abattoir we aimed to target 3 levels of abattoir staff, each knowledgeable about a different level of abattoir activities, and likely to provide us with different views:

- Abattoir Owners
- Line Managers
- Meat Inspectors

In addition to these, we targeted Veterinary Public Health Officers, responsible for Abattoir Inspections at each abattoir, DOA project committee members, and representatives of companies charged with providing independent meat inspectors to abattoirs. See below the Geographic Location and Meat Type of the locations selected for inclusion in the evaluation. On the next page, we present a table describing the sample in greater detail.

Types of meat	Throughput Classification	Daily Throughput (units per day)	EU or South African regulated Abattoir	Comments
Pork	High Throughput	425	South African	One of the highest producing red meat abattoirs.
Poultry	High Throughput	320000	South African	One of the highest producing poultry abattoirs.
Poultry	High Throughput	400	South African	
Cattle, Sheep, Pigs	High Throughput	100	South African	
Poultry, Rabbits	Low Throughput	850	South African	
Cattle, Sheep, Pigs, Game B & C	Low Throughput	5	South African	
Cattle, Sheep, Pigs, Game B & C	Low Throughput	15	South African	
Poultry	Low Throughput	500	South African	
Poultry	High Throughput	300000	South African	One of the highest producing poultry abattoirs.
Poultry	Rural Throughput	50	South African	
Cattle, Sheep	High Throughput	50	South African	
Poultry	Low Throughput	800	South African	
Ostrich, Cattle, Sheep, Pigs, Game B & C.	High Throughput	80	European Union	
Cattle, Sheep, pigs	High Throughput	25 (65p)	South Africa	
Ostrich, Game B & C	High Throughput	225	European Union	
Ostrich	High Throughput	505	European Union	

Table 2: Sample Description

Approach to Analyses

HAS Data Collection and Cleaning

Hygiene Assessment System (HAS), and inspection data were collected from the Western Cape Department of Agriculture. An Alacrity researcher recorded the HAS data present in all physical files that matched our sample of 16 abattoirs. Our intention was to generate a longitudinal data set for all 16 abattoirs (accounting for as many years of inspections as we could locate). These were then entered into IBM SPSS 22. We then investigated the HAS scores in our data set to learn more about the measure, and to better understand how scoring patterns changed over time. During this process we noted the following:

We could not locate the HAS records for 1 abattoir and so our data represents the remaining 15 abattoirs.

In total we collected 112 records. For 5 of these, we could not identify the year of submission as it was not recorded at the top or bottom of the sheet, and these were removed. For a further 3 submissions, these appeared to be duplicates of other records and this is likely due to the way we photographed and captured these records. These were also removed. We removed 2 records due to a missing HAS scoring sheet. These records were captured from letters that had been drafted by VPHOs containing a weighted total score, but no other information. Finally, we reviewed all records to determine whether we had enough data for each year to reliably present a mean for abattoirs. HAS records collected ranged from 2008 to 2019. We determined that 6 or more abattoirs needed to have records for a particular year to include the year in analyses. In addition, we excluded any records that contained anomalies or missing HAS categories. We used paper records to confirm that these were indeed missing before exclusion in most cases. We discovered that 2008, 2009, and 2019 did not have sufficient records to be included in analyses. After these exclusions, this left 89 records available for analysis, representing a period of time from 2010 until 2018.

HAS Analysis Approach

In light of the points noted above, the primary mode of analysis of this data was descriptive. We were interested in interpreting HAS category scores over time in the context of abattoir features that might help explain the development of abattoir performance. In this case, the two greatest predictors of abattoir context were abattoir meat type (being red meat or poultry) and abattoir grade (being rural throughput, low throughput, and high throughput). As we only had 1 rural throughput abattoir, this abattoir was treated as low-throughput, as this was the nearest and most similar category. In addition, we identified those abattoirs that were EU Registered exporters, and added this as a new grade. This was appropriate, as these abattoirs are expected to adhere to the most rigorous standards if they expect to export their products.

To add to this descriptive data, we also conducted two types of model. The first is a set of correlations, divided by abattoir grade. This correlation is concerned with the relationship between year of inspection and HAS category scores. The purpose of this is to identify changes over time within abattoir grades (low throughput, high throughput, and EU Registered). This analysis does not concern itself with the effect of meat type, as this is known in our data to be a smaller effect. Rather a General Linear Model (our second model) is constructed to examine the interaction between meat type and abattoir grade. These are included as factors in the model (as they are categorical), and year is included as a covariate. To reiterate, the intention of this model is to measure the relative effects of abattoir grade, and abattoir meat type, while controlling for (negating) the effect of the year of inspection.

Interview Analysis

In order to explain the findings of the HAS analysis, semi-structured interviews were conducted with:

- Abattoir Owners or General Managers (*n* = 21);
- Line Managers (*n* = 18);
- Meat Inspectors (*n* = 12);
- Veterinary Public Health Officers (*n* = 8);
- Agency Managers (Meat Inspection; *n* = 1);
- Project Committee (*n* = 7)

Abattoir Owners and/or General Managers at all sites provided information, necessary to identify high-level problems that abattoirs deal with on a day-to-day basis. Line Managers assisted in the identification of barriers to implementation. Evidence suggests that Line Managers play a crucial role in maintaining the communication, guidance, coaching and recognition of performance amongst employees (Purcell, Kinnie, Hutchinson, Rayton, & Swart, 2003). Thereby helping to monitor, guide, and encourage employees to perform well in areas of their job that support meat safety. Finally, Meat Inspectors completed a semi-structured interview, to identify gaps in knowledge, attitudes and behaviour necessary to support successful compliance with regulations. All interview schedules can be found in Appendix A.

Analysis of interviews was a multi-step process. All interviews were recorded. A sample of 20 interviews were selected by the interview team from all 67 interview recordings. These 20 were

those interviews that the interview team regarded, in their judgment, as the best in terms of the variety of responses made by the interviewees. These interviews were then listened to again, and interviewee responses were used to draw out categories of responses (these may also be thought of as themes in other paradigms), based on what the interviewee said in response to questioning. For example, if an interviewee mentioned that there was a lack of training provided on meat safety legislation, then the interview team would categorise this item as "a need for training on meat safety", or something to that effect.

The remaining 47 interviews were then listened to by the interview team, all responses to questions were then organised into their categories and captured as frequencies. Any new categories that emerged (or notable subcategories) during these later interviews were discussed by the interview team and were added in a process of continual category iteration. In this way, the interviewees' responses across all abattoirs assisted the team in determining response categories. Finally, quotes were extracted and added to provide additional context for interpretation during analysis. We present graphs of all interview questions, including frequencies of categories of response in Appendix B.

Results

To help us provide a meaningful presentation of the findings of this evaluation, we split this section into two parts. The first part presents the learnings of the contextual review and impact evaluation. The second part presents the findings of the design evaluation. In this first part, we found that the findings of the contextual review and impact evaluation worked well together. The impact evaluation (Question 1) provides conclusions about abattoirs of different types that are quantifiable, using the HAS, and the contextual review (Questions 2 & 3) tells us what this may mean for the South African public. A further expanded Contextual Review and Impact Evaluation section with a more detailed treatment data is provided from page 30 to page 53 of Appendix E, with additional statistical tables in Appendix C.

Contextual Review and Impact Evaluation

The Influence of Abattoir Inspections and Abattoir Hygiene Assessments (and Associated Departmental Interventions) on Meat Safety, Public Health, and Economic Prosperity.

Each abattoir is responsible for the constant management and monitoring of their hygiene management systems, which they are required to establish through the guidance of regulations contained within the Meat Safety Act of 2000. In addition, these regulations require that abattoirs establish important control points (i.e. ante-mortem and post-mortem meat inspection) and corrective actions to lower the risk of biological, chemical, and physical hazards being introduced into the food supply chain. These control points are represented as

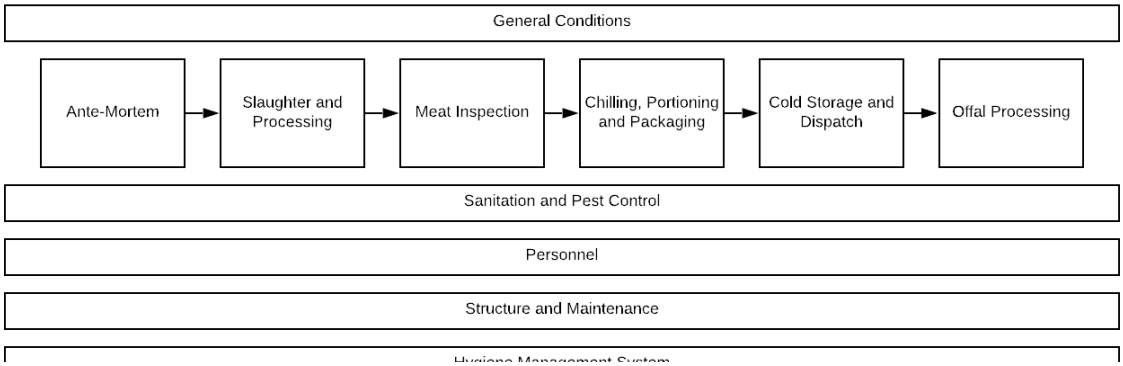


Figure 2: Abattoir Factor Flowchart

the HAS categories presented in the figure below. Abattoir inspections and abattoir hygiene assessments are vital for ensuring that abattoirs continue to comply with all meat safety regulations described in the Act. This facilitates compliance monitoring and increases the likelihood that abattoirs will be able/willing to comply with the meat safety regulations.

As each of these categories represents a different area of meat safety, enhancement of performance in these categories should result in lower risk of contamination. Some of these categories represent opportunities for direct contamination of the product (due to their relationship with the production line), particularly the area of the figure linking Ante-Mortem to Offal Processing. Other categories have an indirect effect, by either influencing the environment around the production line, or determining how personnel behave around the product. Increasing HAS scores across all categories helps prevent the contamination and spoilage of meat while it is being processed in the abattoirs, and lowers the risk of microbiological, chemical, and physical hazards making their way to the consumer, causing illness.

The most common cause of foodborne illnesses are diarrhoeal disease agents such as norovirus, *Campylobacter* spp., and non-typhoidal Salmonella Enterica (NTS) (World Health Organisation, 2015). It is estimated that diarrhoeal disease agents caused an estimated 230,000 deaths in 2010, globally. Both *Campylobacter* spp. and NTS are common meat-borne contaminates, which can be introduced at multiple points in the food supply chain (FSC). All these strains are prevalent In South Africa, though high levels of under-reporting make accurate disease estimates incredibly difficult to obtain. Based on World Health Organisation (WHO) estimates, foodborne illnesses may be responsible for over 142,000 mortalities in Sub-Saharan Africa every year. Most of these fatalities may be attributed to non-typhoidal *Salmonella* serovars, many of which can thrive on unhygienically handled or slaughtered meat. Departmental abattoir inspections are key to ensuring that all abattoirs continue to improve their performance on the HAS, and therefore, improve their level of compliance with meat safety regulations, which mitigate the effects of food-borne disease in South Africa.

Increasing HAS performance through effective abattoir inspections is also vital for ensuring that meat remains an available, trusted and safe source of protein and nutrition. South Africa continues to suffer from high rates of malnutrition due to high levels of poverty and deprivation (Vorster, 2010). Reoccurring outbreaks of foodborne illness related to contaminated or spoiled meat may hurt public confidence in the safety of meat products (Food and Agricultural Organisation of the United Nations, 2016). Depending on type and cut of meat affected, certain sections of the population may find locating a suitable substitute very difficult, or, in extreme circumstances, impossible. This may increase the risk of malnutrition, especially in populations with high levels of food scarcity. A General Linear Model allowed us to produce a ranking of the safest and least safe abattoirs for Ante Mortem, Meat Inspection and Marking, Cold Storage and Dispatch, Sanitation and Pest Control, General Conditions, and the Hygiene Management System. We found that those who are most likely to struggle most with these issues are Low Throughput abattoirs (particularly red meat). Those least likely to struggle with these issues are EU regulated abattoirs, and High throughput abattoirs. Thus, the context of operation for Low Throughput abattoirs is undoubtedly the most challenging.

Increasing HAS performance may assist in shielding the public from exposure to new viral, bacterial, or fungal strains which humanity has not yet encountered. This in turn limits the need for the rapid development and distribution of novel vaccines to treat the spread of novel pathogens, the spread of which may have been entirely preventable. There is evidence that both novel zoonotic strains and the treatments developed to prevent them can have unknown health consequences. The development of new vaccines can be incredibly costly and carry a degree of risk, as side effects associated with new treatments are not always entirely avoidable or predictable (Sarkanen et al., 2018).

The very recent outbreak of 2019-nCoV exemplifies the considerable health risk posed by meat to society, and what can occur when important regulatory oversight is absent. As of the 26th January 2020, a new strain of coronavirus (2019-nCoV) was identified in 2014 individuals, in 11 countries (World Health Organisation, 2020). This represented an increase of 694 new cases since the previous report published the day before (World Health Organisation, 2020). The situation report published on 12 April 2020 places the total number of confirmed cases at 1,696,588 worldwide, indicating a further increase of 85,679 confirmed new cases in the previous 24 hours, and a total of 105,952 deaths since the start of the pandemic (World Health Organisation, 2020). An epidemiological link has been established between 2019-nCoV and Huanan Seafood Wholesale market where live animals are often on sale (Hui et al., 2020). Research shows that Covid-19 has many similarities to coronaviruses which are found in bat and pangolin populations. Despite this fact, no coronavirus has been identified which bears sufficient genetic similarity to COVID-19, for it to be able to be viewed as a precursor to the virus (Andersen et al., 2020). The emergence of this new pathogen further highlights the potential risk posed by the consumption of both live and slaughtered animals to human populations, especially when it occurs without the proper oversight. It also demonstrates the speed at which a new pathogen can spread in densely populated, urban settings (Hui et al., 2020).

The growing size of 'anti-vax' communities makes the careful testing and development of vaccines even more vital, as any unexpected side effects, no matter how small or rare, may be easily exploited by those wishing to damage public confidence in vaccines. It is, therefore, imperative that measures which play a major role in safeguarding the public health from harmful zoonoses, such as abattoir inspection, are supported and improved, where possible. This not only protects the public health but may also assist in safeguarding public confidence in other areas of biomedicine by removing opportunities for unjust or uninformed criticism of its practices.

Given this background (and our findings regarding low throughput abattoirs), it is encouraging to note that average HAS scores across abattoirs in this sample have increased steadily since 2010. The figure below shows that, on average, abattoirs generally perform above the Bronze rating across HAS categories (the 60 point level and the minimum level necessary to receive a rating), and are approaching the silver level (a score of 80).

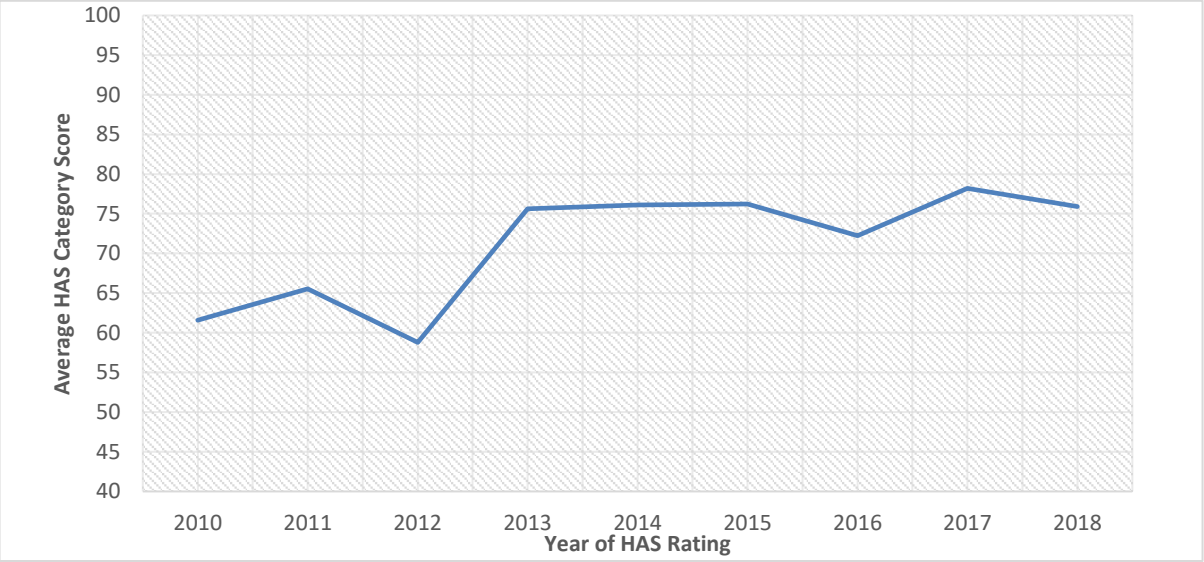


Figure 3: Category Performance by Year

This evidence suggests that overall, abattoir inspections, and associated interventions, have assisted to increase the average performance rating of abattoirs on HAS categories, and thus, these control points should be safer. We further investigated Low Throughput, High Throughput, and EU Regulated HAS category ratings and made the following observations:

For Low Throughput abattoirs, in the first 3 years of our sample (2010, 2011, and 2012), 64% of HAS category ratings performed too poorly to receive a rating and were therefore below the minimum standard, and this decreased to 23% of HAS category ratings in the last 3 years of our sample (2016, 2017, and 2018) – an improvement of 41%. Silver or greater ratings have also improved from 6% to 16% of HAS category ratings in our sample. Although, these abattoirs still need additional attention and support due to their more challenging context.

For High Throughput abattoirs, only 9% of HAS category ratings in the first 3 years performed too poorly to receive a rating, and this decreased to 4% of HAS category ratings in the last 3 years – an improvement of 5%. Silver or greater ratings have remained constant at 43%.

For EU Regulated abattoirs, only 5% of HAS category ratings in the first 2 years performed too poorly to receive a rating (2011 and 2012 – there was no data for 2010 for EU Regulated abattoirs), and this decreased to 0% of HAS category ratings in the last 3 years – an improvement of 5%. Silver or greater ratings have also improved from 38% to 73% of HAS category ratings in our sample. In order to better understand this result, we investigated individual HAS category scores, and how they improve over time.

First, we present the categories with the closest proximity to the product here. These scores represent the correlation, or the strength of the relationship between HAS Category score and year of inspection. An asterisk is marked for significant correlations ($p < .05$), and a double asterisk is marked for a very significant correlation ($p < .01$). Due to the number of records available for each throughput level, it is likely that we could only detect moderate or larger correlations. Despite this, it is clear that low throughput abattoirs have improved the most over time (improving in all categories presented in Table 4). EU Registered abattoirs and high throughput abattoirs both started with relatively high scores, near or above silver performance, and have largely maintained this performance level (although EU Registered abattoirs made significant gains in Cold Storage and Dispatch).

Throughput level (n)	Ante Mortem	Slaughtering and Processing	Meat Inspection and Marking	Chilling Portioning and Packaging	Cold Storage and Dispatch	Offal Processing
EU (15)	.47	.483	.214	NA	.582*	.199
High (42)	.017	-.169	-.024	.173	.157	-.123
Low (32)	.497**	.455**	.558**	.505*	.360*	.360*

Table 3: Bivariate Correlations by Throughput Level

Next, we present those HAS categories with a more indirect and overarching effect on the product. The evidence presented in Table 5 suggests that Low Throughput abattoirs have made significant progress in terms of General Conditions, and the Hygiene Management System. EU Regulated abattoirs have made significant improvement in terms of their Personnel score.

Throughput	Sanitation and Pest Control	Personnel	Structures and Maintenance	General Conditions	Hygiene Management System
EU (15)	.497	.550*	.448	.195	.478
High (42)	.06	0.19	-.024	.165	.031
Low (32)	.238	.224	.245	.377*	.390*

Table 4: Bivariate Correlations by Throughput 2

What Does This Mean for Vulnerable Populations?

Raising HAS category scores in Low Throughput abattoirs is vital for safeguarding the health of vulnerable populations in South Africa, as many of these abattoirs are situated in rural areas and serve the rural populations. HIV prevalence in rural areas is high, with some research reporting infection rates at 45.3% for men and 46.1% for women between the ages of 35 and 39 (Gómez-Olivé et al., 2013). South Africa's high prevalence of HIV makes millions of individuals particularly vulnerable to the ill-effects of meat-borne related infection and sequalae, which can easily be contracted through the consumption of contaminated meat, resulting from cross-contamination or improper preparation (Gordon et al., 2002). Evidence suggests that patients with pre-existing comorbidities may also be at greater risk of developing NTS and *Campylobacter* related sequalae such as reactive arthritis, irritable bowel syndrome, Guillain-Barre syndrome, and Reiter's syndrome (Gordon et al., 2002). AIDS patients suffering with non-typhoidal Salmonellosis bacteraemia have experienced mortality rates of between 35% and 60%, with 25% to 45% of survivors becoming re-infected within 6 months of recovery. Evidence suggests that HIV-positive patients are 20 times more likely to contract NTS than immunocompetent patients. Data taken from other HIV positive populations in other African countries show similarly severe mortality rates with respect to NTS infection. A study conducted by Gordon et al. (2002) examined the mortality rate and risk of recurrence of NTS in a population of 100 HIV infected adults who were admitted to a state hospital and who were treated with Chloramphenicol. The study group showed an inpatient mortality of 47% and a 1-year mortality of 77%. Children under the age of 5 also appear to be particularly vulnerable.

All these bacterial strains are potentially meat-borne and may be spread through the consumption of unhygienically slaughtered and improperly stored meat. The high consumption of unregulated meat in rural areas of South Africa makes exposure to meat-borne sources of infection increasingly likely. As mentioned above, the improvement observed in our sample of Low Throughput abattoirs is an important safeguard for the health of these vulnerable rural populations. In addition, these abattoirs are an important employer, and provide financial security in these areas too. Trust in the meat produced by these abattoirs is vital, both for the food security of the community, and for the economic wellbeing of the abattoir itself. Beyond this more localised economic benefit, improving HAS scores through effective Abattoir inspections helps promote a strong economy. This happens by preventing the considerable economic costs which can arise because of meat-borne illness. The death and sickness which can result from contaminated meat can, in turn, cause substantial economic loss to the individual and the economy.

The outbreak of listeriosis in South Africa in 2017-2018 gives evidence of the considerable economic impact which foodborne disease can have on producers, consumers, and the economy. The aggregate monetary loss to the processing industry was 164 million rand, not including the cost of disposal or incineration of contaminated meat (Olanya et al., 2019). The financial burden to producers was worsened by the temporary suspension of processed meat exports to the South African Development Community in the wake of the outbreak. The losses

caused by these restrictions were estimated at 151.77 million rand. Productivity losses were estimated at 6.118 million rand, which only amounts to 0.22% of total costs attributable to the outbreak. The cost valuation of the 204 cases, which ended in death, was estimated to be 3.868 billion rand ($260 million) in total (Olanya et al., 2019). While the source of this outbreak appears to have come from a foreign source, abattoir inspections and effective regulations in South Africa prevents local facilities from becoming reservoirs for other harmful bacteria.

Design Evaluation

This section of the results is focused on identifying weaknesses in the current system. We present an examination of attitudes toward Abattoir Inspections, a summary of common challenges and recommendations for resolving these, and an examination of meat safety systems currently used by the department, with commentary and further recommendations to improve these systems. A further expanded Design Evaluation section with a more detailed treatment of the data is provided from page 54 of Appendix E.

Attitudes Toward Abattoir Inspections and Associated Activities

The vast majority of Abattoir Owners, Line Managers, and Meat Inspectors have positive attitudes towards the regulation of animal slaughter and meat processing. This was expressed in a number of different ways during interviews, and this is explored in greater detail in this section. Generally, it is felt that Meat Safety is very important, and it is claimed by these parties that Meat Safety is considered seriously at every step of the abattoirs processes. Many abattoirs also claim that they do not need to prepare for external inspections because regulations are tightly integrated into their day-to-day practices.

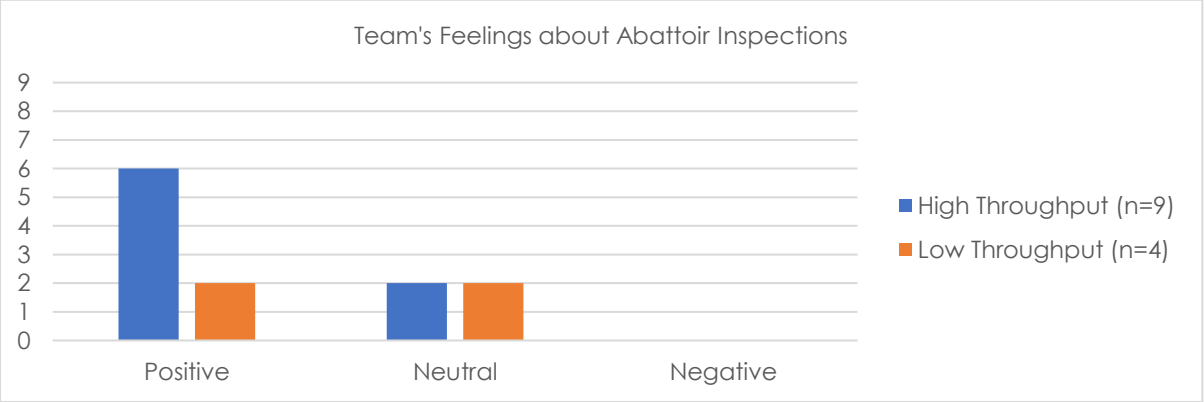


Figure 4:Team's Feelings about Abattoir Inspections

Line Managers in Abattoirs class their teams as engaged and compliant with Meat Health and Safety.

Some Line Managers believe that their team members see Abattoir inspections (both internal and departmental) either positively or in a neutral manner. It is important to note in the graphs below, that although Line Managers believe that their teams do not see inspections in a negative way, some Line Managers, themselves, stated that inspections have minimal or no influence or have a disruptive influence on how they operate.

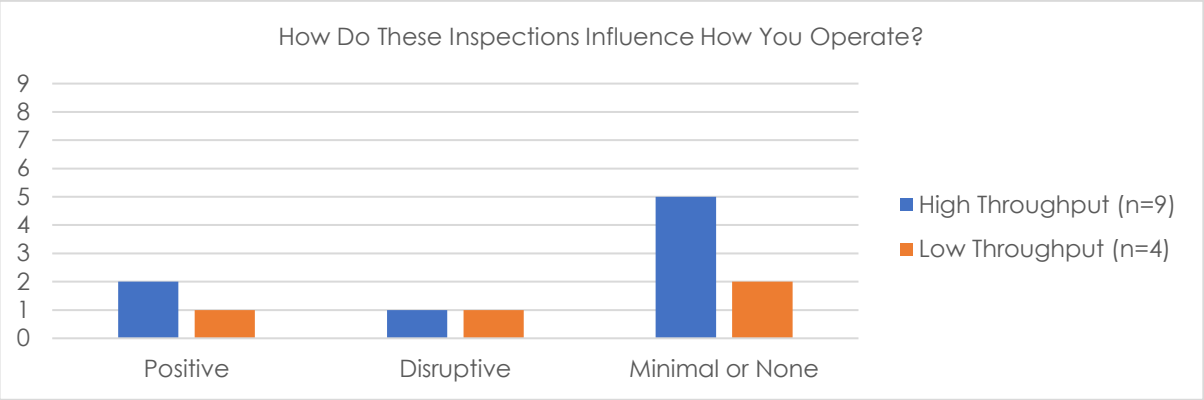


Figure 5: How Do These Inspections Influence You?

A positive point to note was that the majority of Abattoir Owners interviewed saw inspections (both internal and departmental) as necessary and important.

It was found in the interviews that the majority of Meat Inspectors feel that Abattoir Owners and Abattoir Employees displayed a good attitude towards the Meat Inspector's role as well as the tasks that they need to do. However, in High Throughput Abattoirs, there seems to be a negative attitude towards Meat Inspectors, and the job that they do, and this may have an impact on the overall effectiveness of this important role.

Line Managers in the Abattoirs suggest that the processes and systems that are used to ensure meat safety are largely important and useful. However, some Line Managers believe that there is a lack of detail or clarity and, thus, could impact the effectiveness of the implementation of these processes and systems.

What Changes Could be Made to Improve Inspections?

We found that the observations made by VPHOs captured the perspectives of Abattoir Owners, Line Managers, and Meat Inspectors comprehensively. Eight VPHOs who serve the abattoirs in our sample (and all abattoirs in the Western Cape), were interviewed, and identified common problems experienced in the abattoirs that they serve. These broadly capture the findings of the other interviewees who received these questions, so for the sake of brevity, we present these here.

The impact of regulations on profit was arguably the most prevalent issue observed by VPHOs (100%). Structural Regulations were mentioned as particularly challenging (100%), followed by the cost of Meat Inspectors (63%). Compounding this problem further, was the scarcity of suitably qualified Meat Inspectors (63%), and an overwhelming need for on the job training (63%).

Lack of suitable skills was mentioned as a general problem within abattoirs, with all levels of employee implicated in some way (38% to 88%). Retention of employees was also identified

as a common challenge for abattoirs, as employees who are more skilled move on to bigger and better forms of employment (63%).

Finally, the general commitment (or willingness) of abattoir employees to meat safety was identified as lacking. This was noted particularly for those in management roles (63%).

Other issues included lack of access to waste management facilities or biological testing labs (50%), and a weak supply of animal stock for slaughter (38%).

The following recommendations were compiled based on some of the most common challenges and barriers observed by interviewees.

Financial Support

In the interviews, there was concern raised that abattoirs are finding it costly to make the regulated changes that are presented to them as corrective action. Further, many abattoirs claim that they cannot afford the correct number of Meat Inspectors. The result is that meat inspectors are either paid poorly or are overworked. A good illustration of some of the context of this is an interview quote from an abattoir owner, "why have first-world regulations on a third-world abattoir and put so much pressure on me that I must close it".

Thus, a subsidy could alleviate the financial pressure on individual abattoirs. This subsidy could be given to abattoirs that fall within particular HAS boundaries for a limited period of time to facilitate adherence to regulations. Another way of managing a subsidy like this draws inspiration from the HPR, discussed in the second part of this section. This approach would allow the government to only provide financial support for the correction of those control points that are both cheap and impactful, based on their economic weighting and hygienic weighting.

Procedural Change

As one Line Manager said, "illegal slaughter makes registered abattoirs angry since they have to follow regulations while the others do not." VPHOs have also stated that the Environmental Impact Assessments is a high barrier of entry for smaller abattoirs which leads to an increase in illegal slaughter as these abattoirs are not able to register. One Veterinary Officer stated, "(Registrations is a) barrier to entry, people consult, but never get beyond contact session". Therefore, a recommendation would be for the Department of Agriculture to work collaboratively with smaller abattoirs to mitigate these barriers. Any lessons learned that make it easier for smaller abattoirs to comply with regulations would also have a positive effect on those abattoirs calling for financial assistance.

Communicate Regulations Effectively

As an abattoir owner expressed, "What was right is now incorrect in the morning". There is considerable uncertainty about the regulations and their relationship with HAS scores. Some abattoirs do not understand why their scores remain the same (or are reduced) after they complete corrective actions. This is partially due to the subjective nature of the HAS, and thus, it is an inherent weakness of the tool. The department should attempt to create operational definitions for different levels of performance on the HAS. Given the sheer number of regulations that the HAS refers to in its guidelines for each category, this would mean the creation of a dictionary of performance level descriptions for (at least) the most important regulations within each HAS category.

It is important that the tool used to conduct measurement is transparent in how it produces a score. With these adjustments, HAS score reliability would improve, and the requirements for a score would help abattoirs improve their scores and understand their scores.

Upskill Veterinary Public Health Officers

Interviews with Line Managers of Abattoirs, Abattoir Owners and Meat Inspectors flagged that some VPHOs are not doing regular visits, not collecting their own samples, and not providing the expected quantity of support to the abattoir. It was also mentioned that the VPHOs interpretation of the Meat Safety Act is viewed as inconsistent and this causes confusion for abattoir management.

It was also mentioned by Low Throughput Abattoirs that VPHOs must take a more collaborative approach with them, so that they can help guide Low Throughput Abattoirs in bettering their performance. Therefore, it is recommended that the Department creates a "Continuous Professional Development" programme (similar to those required by the Health Professions Council of South Africa). This programme could be delivered to both VPHOs and Meat Inspectors to ensure their knowledge and skills are kept up to date. We recommend training is provided to both parties so that both internal and external inspections are thorough, consistent and aligned.

Employ Meat Inspectors Through the Government

A common theme that came out of the interviews was the belief that Meat Inspectors should be employed by the Government, and not the individual abattoirs. Sometimes this was expressed as a part of the "cost of meeting regulations". A quote from the interviews expresses the following position of a VPHO: "Smaller guys [abattoirs] cannot financially support or employ a guy [meat inspector] permanently to be there every day when he slaughters". This shows the financial burden this has on abattoirs, especially Low Throughput and Rural Abattoirs.

Another benefit would be a resolution of the conflict of interest that currently exists between abattoirs and Meat Inspectors. Some Meat Inspectors state their authority is diminished, recommendations are not taken seriously and/or there is a limit to which recommendations they can provide to abattoirs - as it is the abattoir that pays their salary at the end of the day. As one Meat Inspector states, "as long as abattoir owners pay MI salaries then there will be loopholes, they [Meat Inspectors] will be bought out". If Meat Inspectors were employed by the Government, they could be more objective, have greater authority, and provide recommendations to work towards better abattoir performance.

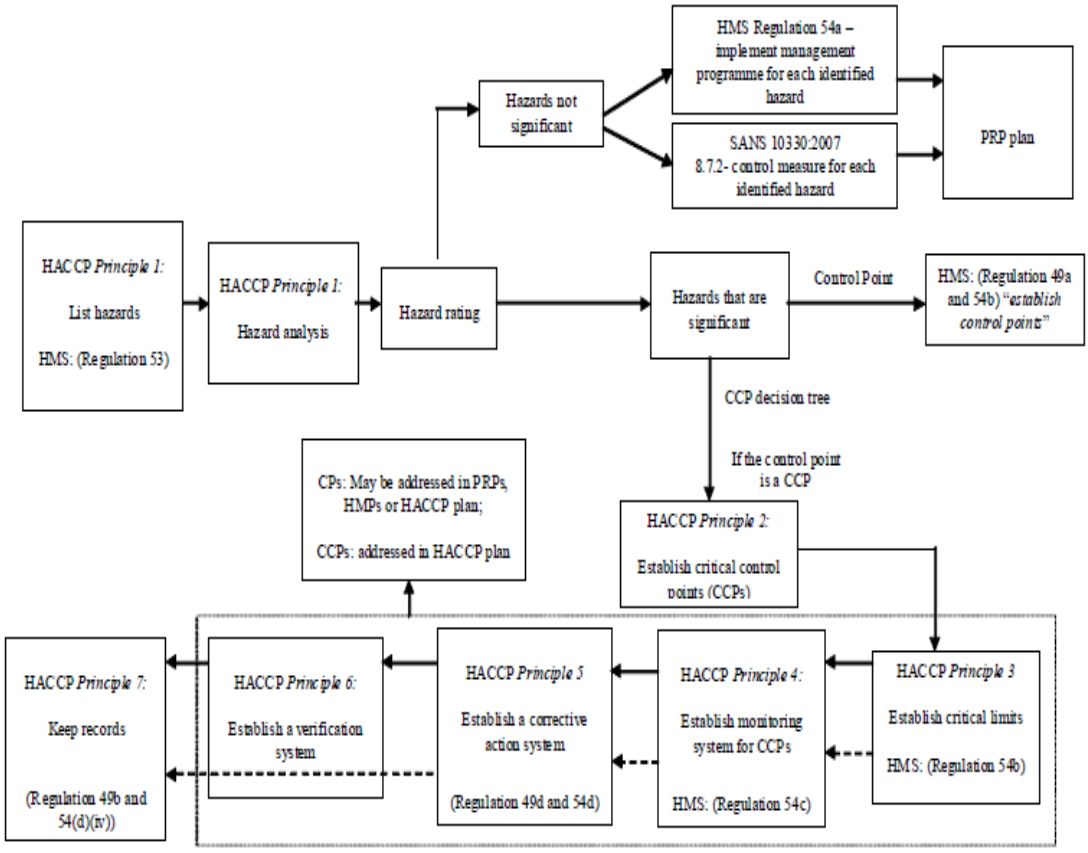
Monitor Training and Development

The interviews indicated that most abattoirs found it difficult to consistently implement meat health and safety properly due to a lack of understanding of requirements. Training and development can assist both the employee and organisation to close skill gaps, through providing the relevant knowledge, skills and abilities to fulfil their job roles, as well as complying with regulations (Greene, 2011). It was noted in the interviews that abattoirs pay a Skills Levy but they do not have sufficient training programmes within the individual abattoirs. Sufficient and regular training should be conducted to ensure all employees have the right skills to fulfil their role but also to foster the employee's commitment to the organisation. Training must be presented in an appropriately accessible way. The practical implications are that training initiatives will need to be regularly conducted and widely distributed in order to reach a mass of abattoir workers and to account for the high turnover of employees (Erian, Sinclair, & Phillips, 2019). Therefore, it is recommended that the Department of Agriculture work more closely with the Agriculture Sector Education Training Authority (AgriSETA), and other relevant government departments, to ensure employees receive relevant and accessible training content. The most direct way that the department may be able to encourage regular training within abattoirs would be by integrating monitoring of training into performance measurement and reporting of abattoirs.

Strengthening Hazard Analysis Within the HMS Through the Inclusion of an HACCP-based Hazard Analysis Approach

Presently, abattoirs are not required to conduct facility-specific hazard analysis and rank hazards based on severity and risk using a predetermined method. This increases the health risk to the consumer, as it is possible that hazards which are unique to individual facilities will go unidentified. Therefore, it is recommended that the Department integrate an HACCP-based hazard analysis approach into the HMS in order to improve hazard identification in individual abattoirs (Govender, 2016). Requiring abattoirs to conduct their own hazard analysis will help abattoir owners and hygiene management teams to acquire a more detailed knowledge of the relevant microbiological, chemical, and physical hazards, as well as the level of risk that they pose the consumer. Research suggests that the HMS would benefit from hazard analysis being made more explicit within the regulations (Govender, 2016). As the HACCP system is not meant to function independently, its union with the HMS is appropriate, as it would complement the HMS structures which are already in place. The structures of the HMS and the HACCP are incredibly similar, with both systems requiring the identification of hazards, the establishment of control points/critical control points, establishment of critical limits, designing a monitoring system, a corrective action system, record keeping, and verification (Govender, 2016). An important difference is that unlike the HACCP, the HMS does not provide abattoirs with guidelines on how hazard analysis needs to be performed.

The figure above depicts a representation of how the HACCP and HMS may be integrated, as presented by Govender (2016), factoring in all the areas in which HACCP principles overlap with HMS regulations. Merging elements of the two systems allows for the effective



identification of control points/critical control points other than those which are contained in the HMS regulations.

Figure 6: Integration framework for HACCP and HMS (Govender, 2016)

Utilising the Scientific Opinions and Scientific Reports Published by the European Food Safety Authority (EFSA) and EFSA Panel for Biological Hazards for Better Identification and Monitoring of Biological Hazards Along the Food Supply Chain

It is recommended that the Department consider utilising the hazards and indicators identified by the EFSA to improve the identification and monitoring of common biological hazards from farm to abattoir (European Food Safety Authority Panel on Biological Hazards - EFSA BIOHAZ Panel, 2013). These reports rank biological hazards based on the assessment of: (1) the magnitude of the human health impact based on data on reported incidence, (2) the severity of the disease in humans based on the number of fatalities among reported cases, and (3) the weight of evidence that meat from specific animals is an important risk factor for disease in humans (EFSA BIOHAZ Panel, 2013). As a result of this process, high priority pathogens were identified and Harmonised Epidemiological indicators (HEI) were established. These HEIs were designed to assist with hazard monitoring in EU countries, regions, abattoirs, and farms. However, these indicators could be used to equally good effect in South Africa too. HEIs are groupings of factors (such as processes and conditions) which correlate with the actual human health risk caused by a hazard, including the microbiological tests, audits, and visual inspections methods, which are used to evaluate the HEIs from the farm to the abattoir. In the case of bovine animals, HEIs were constructed for *Salmonella,* Pathogenic VTEC, Taenia saginata, and mycobacteria, with *Salmonella* and Pathogenic VTEC being identified as high priority hazards. HEIs for high priority hazards have also been constructed and published for poultry, swine, sheep, and goats. Evidence gathered at particular HEIs can be used to generate risk profiles for livestock while on the farm, during transport and lairage, and before and after slaughter.

The figure above serves as an example of the HEI's which have been identified for *Salmonella* in bovine animals, and where they are situated on the food supply chain. Please consult

Indicators (animal/ food category/other)	Food chain stage	Analytical/diagnostic method	Specimen
HEI 1: Practices which increase the risk of introducing *Salmonella* into the farm (purchase policy, mixing with other herds, access to pasture, access to surface water)	Farm	Auditing	Not applicable
HEI 2: On-farm practices and conditions	Farm	Auditing	Not applicable
HEI 3: *Salmonella* status of the group(s) of bovine animals containing animals to be slaughtered within one month	Farm	Microbiology	Pooled faeces
HEI 4: Transport and lairage conditions	Transport and lairage	Auditing	Not applicable
HEI 5: Visual inspection of hide conditions of animals at lairage (clean animal scoring system)	Slaughterhouse	Visual inspection	Not applicable
HEI 6: *Salmonella* on incoming animals (after bleeding and before dehiding)	Slaughterhouse	Microbiology (detection and serotyping)	Hide swabs
HEI 7: *Salmonella* in incoming animals (evisceration stage)	Slaughterhouse	Microbiology (detection and serotyping)	Lymph nodes
HEI 8:. *Salmonella* on carcases pre-chilling	Slaughterhouse	Microbiology (detection and serotyping)	Carcase swabs
HEI 9: *Salmonella* on carcases post-chilling	Slaughterhouse	Microbiology (detection and serotyping)	Carcase swabs

Figure 7: 'Table 1: Harmonised epidemiological indicators for Salmonella in bovine animals' from EFSA Scientific Report (EFSA, 2013)

Appendix E (pg. 106) for a full description of the HEIs identified for particular hazards in bovine.

Adoption of the Hygiene Performance Rating (HPR) System for Auditing Abattoir Hygiene

It is recommended that the Department consider the adoption of a new auditing tool to replace the HAS system, which is currently in use. The HPR system is the only system with evidence supporting an association between its results and bacteria levels detected on carcasses. It is the position of Alacrity Development that the design and structure of the HPR tool is of a high quality. The Hygiene Performance Rating system was developed by Animalia and has been used for monitoring slaughter hygiene (abattoir inspections) in Norwegian abattoirs for the last 10 years. The HPR is based on a visual, systematic evaluation of hygienic practices in abattoirs, which is performed by one trained external assessor. In accordance with the HPR protocol, factors that can affect slaughter hygiene at control points along the slaughter line should be assessed in detail, with particular attention paid to the operators' hygienic behaviour and risk handling of carcasses. Each control point is given a score that is recorded electronically. The HPR protocol is divided into chapters, each of which contains multiple control points (questions). These chapters represent positions along the slaughter line, or other areas of the abattoir judged to influence slaughter hygiene (Røtterud, Gravning, Hauge, & Alvseike, 2020).

The HPR offers an extremely detailed approach to auditing slaughter hygiene in abattoirs. Unlike the HAS, the HPR has firm operational definitions for indicators and levels of performance which should be repeatable. This means that criteria supporting the awarding of particular scores are explicit and transparent, and abattoirs will be able to better use the results of the tool to improve their performance. The HPRs numerous control points (questions) allows for each chapter (section) to be investigated thoroughly and with a high degree of accuracy. The control points or questions have a predefined range of what infringements are acceptable, when improvements are necessary, and what infringements are not acceptable. All scores are also weighted for hygienic impact and for economic impact (Røtterud et al., 2020). Another promising feature of the HPR is that, unlike other systems, the 'worst' or most severe breach in operational hygiene is recorded, rather than the mean value of all observed infringements (Røtterud et al., 2020). The protocol penalises the abattoir more if the possible solutions, which would increase the likelihood of operators being able to perform in compliance with regulations, are easy or cheap to implement (Røtterud et al., 2020). As the body of research comparing abattoir inspection tools to bacterial levels on carcasses is still exceedingly small, it is not possible to comment on how the HPR compares to other abattoir inspection tools in this respect, including the HAS. Please consult Appendix E (pg. 120) for a full description of the HPR protocol and its place in the literature.

Incentivising Farmers to Reduce Risk Through the Use of Biosecurity Interventions at the Farm Level

It is recommended that the Department consider providing incentives to farmers to adopt biosecurity measures, which will assist with reducing or eliminating hazards while on the farms. The body of research suggest that control measures placed at the farm level can be a useful means of reducing the prevalence of infections in livestock such as Campylobacteriosis and Salmonellosis (Frazer et al., 2010). However, the additional costs associated with new biosecurity will likely be met with resistance in absence of additional incentives to protect the health of the public. One of the barriers to the success of Salmonella control programmes in the UK was the absence of any tangible benefit to the farmers for implementing disease control programmes (Frazer et al., 2010). Penalties or financial incentives may be necessary to

encourage farmers to keep levels of Salmonella, and other pathogens of public health significance at acceptable levels (Frazer et al., 2010).

Next Steps

In order to recognise much of the positive health and economic benefits outlined in this report, two research activities must be done. First, the department should seek to better understand how smaller and more rural abattoirs relate to meat consumption in surrounding communities. These communities cannot receive the protective benefit outlined here without frequent access to these abattoirs and their produce. Second, the department should investigate how illegal slaughter fits into this picture and develop a strategy to induct illegal slaughterers into the legal market.

Further Resources

The Head of Food Safety at Animalia, Dr. S. J. Hauge, has informed Alacrity Development that Animalia would be open to collaborating with other organisations/governments in order to translate the HPR into English, train assessors, and other necessary requirements, if the Department wishes to adopt the system for its own operations. The Department should contact Dr. Hauge, or another one of Animalia's representatives, if it wishes to pursue this further. Contact details can be easily obtained through their website at https://www.animalia.no .

It is highly recommended that the Department consult the relevant Scientific Opinions and Scientific Reports (listed below) published by the EFSA to see how its own monitoring systems might benefit.

• European Food Safety Authority Panel on Biological Hazards (EFSA BIOHAZ Panel). (2011). Scientific Opinion on the public health hazards to be covered by inspection of meat (swine). EFSA Journal, 9(10), 2351.

• European Food Safety Authority (EFSA). (2011). Scientific Report of EFSA: Technical specifications on harmonised epidemiological indicators for public health hazards to be covered by meat inspection of swine. 9(10), 2371.

• European Food Safety Authority Panel on Biological Hazards (EFSA BIOHAZ Panel). (2012). Scientific Opinion on the public health hazards to be covered by inspection of meat (poultry). EFSA Journal, 10(6), 2741.

• European Food Safety Authority (EFSA). (2012). Scientific Report of EFSA: Technical specifications on harmonised epidemiological indicators for biological hazards to be covered by meat inspection of poultry. EFSA Journal, 10(6), 2764.

• European Food Safety Authority (EFSA). (2013). Scientific Report of EFSA: Technical Specifications on harmonised epidemiological indicators for biological hazards to be covered by meat inspection of domestic sheep and goats. EFSA Journal, 11(6), 3277. • European Food Safety Authority Panel on Biological Hazards (EFSA BIOHAZ Panel). (2013). Scientific Opinion on the public health hazards to be covered by inspection of meat from sheep and goats. EFSA Journal, 11(6), 3265.

References

Andersen, K.G., Rambaut, A., Lipkin, W.I., Holmes, E.H., & Garry, R.G. (2020). The proximal origin of SARS-CoV-2. *Nat Med*, https://doi.org/10.1038/s41591-020-0820-9.

Christou, L. (2011). The global burden of bacterial viral and zoonotic infections. *Clinical Microbiology and Infection*, 17, 326-330.

Department of Agriculture, Forestry, and Fisheries. (1999). *Cattle (Bovine) Tuberculosis: Information Pack.* Pretoria: Department of Agriculture, Forestry, and Fisheries.

European Food Safety Authority (EFSA). (2013). Scientific Report of EFSA: Technical specifications on harmonised epidemiological indicators for biological hazards to be covered by meat inspection of bovine animals, *EFSA Journal*, 11(6), 3276.

European Food Safety Authority Panel on Biological Hazards (EFSA BIOHAZ Panel). (2013). Scientific Opinion of the public health hazards to be covered by inspection of meat (bovine animals). *EFSA Journal*, 11(6), 3266.

DPME. (2014). *Guideline on Design Evaluation*. The Presidency: Republic of South Africa.

Erian, I., Sinclair, M., Phillips, C.J.C. (2019). Knowledge of stakeholders in the livestock industries of East and Southeast Asia about welfare during transport and slaughter and its relation to their attitudes to improving
animal welfare. *Animals*, 9(3) 2-15.

Food and Agricultural Organisation of the United Nations (FAO). (2016). *Economic Analysis of Animal Diseases*. Rome, Italy. United Nations.

Frazer, R.W., Williams, N.T., Powell, L.F., & Cook, A.J.C. (2010). Reducing and Campylobacter and Salmonella Infection: Two Studies of the Economic Cost and Attitude to Adoption of On-farm Biosecurity Measures. *Zoonoses and Public Health*, 57, e109-e115.

Gomez-Olive, F.X., Angotti, N., Houle, B., Klipstein-Grobusch, K., Kabudula, C., Menken, J., Williams, J., Tollman, S., & Clark, S.J. (2013). Prevalence of HIV among those 15 and older in rural South Africa. *AIDS Care*, 25, 1122-1128.

Gordon, M.A., Banda, H.T., Gondwe, M., Gordon, S.B., Boeree, M.J., Walsh, A.L., Corkill, J.E., Hart, C.A., Gilks, C.F., & Molyneux, M.E. (2002). Non-typhoidal salmonella bacteraemia among HIV infected Malawian adults: high mortality and frequent recrudescence. *AIDS,* 16, 1633-1641.

Govender, R. (2016). A review of HACCP and the South African abattoir hygiene management system towards integration. *International Journal of Food Safety Nutrition and Public Health*, 6, 65 – 84.

Greene, R. J. (2011). *Rewarding performance: guiding principles; custom strategies*. New York: Routledge.

Hui, D.S., Azhar, E.I., Madani, T.A., Ntoumi, F., Kock, R., Dar, O., Ippolito, G., Mchugh, T.D., Memish, Z.A., Drosten, C., Zumla, A., & Petersen, E. (2020). The continuing 2019-nCoV epidemic threat of novel coronavirus outbreak in Wuhan, China. *International Journal of Infectious Diseases,* 91, 264-266.

Macpherson, C.N.L. (2005). Human behaviour and epidemiology of parasitic zoonoses. *International Journal for Parasitology*. 35, pp. 1319-1331.
Meat Safety Act, 2000 (ACT No. 40 of 2000): Red Meat Regulations. Retrieved from https://www.nda.agric.za/vetweb/Legislation/Meat safety/RED MEAT REGS 2004.pdf.

Olanya, O.C., Hoshide, A.K., Ijabadeniyi, O.A., Ukuku, D.O., Mukhopadhyay, S., Niemira, B.A., Ayeni, O. (2019). Cost estimation of listeriosis (*Listeria Monocytogenes)* occurrence in South Africa in 2017 and its food safety implications. *Food Control,* 102, 231-239.

Patton, M.Q. (2002), *Qualitative research and evaluation methods*. 3rd Edition. Sage Publications. Thousand Oaks: CA.

Purcell, J., Kinnie, N., Hutchinson, S., Rayton, B., & Swart, J. (2003). Understanding the People and Performance Link: Unlocking the Black Box. London, U. K.: Chartered Institute of Personnel and Development.

Rossi, P. H., Lipsey, M. W., & Freeman, H. E. (2004). Evaluation: A systematic approach. London: Sage publications.

Røtterud, O.J., Gravning, G.E.N., Hauge, S.J., & Alvseike, O. (2020).
Hygiene performance rating - An auditing scheme for evaluation of slaughter hygiene. *MethodsX,* 7, 100829.

Sarkanen, T.O., Alakuijala, A.P.E., Dauvilliers, Y.A., & Partinen, M.M. (2018). Incidence of narcolepsy after H1N1 influenza and vaccination: Systematic review and meta-analysis. *Sleep Medicine Reviews*, 38, 177-186.

Swanson, M.W. (1977). The sanitation syndrome: Bubonic plague and urban native policy in the Cape Colony, 1900-1909. *The Journal of African History,* 18(3), 387-410.

Taubenberger, J & Morens, D.M. (2006). 1918 Influenza: The mother of all pandemics. *Emerging Infectious Disease,* 12(1), pp.15-22.

Vorster, H.E. (2010). The link between poverty and malnutrition: A South African perspective. Health SA Gesondheid, 15, 1-6.

World Health Organisation (WHO). (2015). WHO Estimates of the Global Burden of Foodborne Diseases: Foodborne Disease Burden Epidemiology Reference Group 2007-2015. Geneva, WHO Press.

World Health Organisation (WHO). (2020, 26 January). Novel Coronavirus: Situation Report-6. Retrieved from https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200126-sitrep-6-2019--ncov.pdf?sfvrsn=beaeee0c_4.

World Health Organisation (WHO). (2020, 12 April). Coronavirus disease 2019 (COVID-19): Situation Report – 83. Retrieved from https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports/.