

Integrating animal health and food safety surveillance data from slaughterhouse control

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Summary

Surveillance at the slaughterhouse level for animal health and food safety purposes encompasses examination for the presence of pathology, pathogens, drug residues, chemical contaminants and antimicrobial resistance. Government, industry and academia are the primary proponents of such surveillance. A variety of policies and policy instruments from voluntary to legislative may be applied to promote or obligate participation. Efforts to integrate data across such diverse organisations encounter significant legal, logistical and financial challenges. Enhancement of policies to encourage effective integration of animal health and food safety surveillance data from slaughterhouse control should promote: a long-term approach; collaboration among government, industry and academia; application of a risk-based scheme; and transparent public access to data, with generation of consumer-oriented communications derived from the data. A strong case can be made that the complementary pursuit of both sustainable animal health and food safety can continue to be aided by surveillance at the slaughterhouse level.

Keywords

Animal – Food – Health – Integration – Policy – Safety – Slaughterhouse – Surveillance.

Introduction

The intent of the authors of this paper is to address the ways in which policies and methods for integrating animal health and food safety surveillance data at the slaughterhouse level could be improved, in order to better inform key decisions to benefit animal and human health. The paper will touch on several areas of technical data capture, with some general challenges and approaches to integration, and cite or suggest best practice examples across a spectrum of issues, considerations and jurisdictions. The paper is intended to reflect both a historical evolutionary and a global perspective.

Surveillance at the slaughterhouse level for animal health and/or food safety purposes is largely carried out through government, industry or academic initiatives, either individually or collaboratively. It may be time-limited to a single risk or research project, or part of a broader

ongoing monitoring programme for certain diseases of animal or public health importance. The policies and policy instruments that underpin such activities are largely determined by the national Competent Authority and the options open to the lead proponent or sponsor, together with a preliminary analysis of the most effective and efficient approach for the intended purpose.

The Codex Alimentarius *Code of Hygienic Practice for Meat* (CHPM) constitutes the primary international standard for meat hygiene and incorporates a risk-based approach to the application of sanitary measures throughout the meat production chain. Ante-mortem inspection is described as a primary component of meat hygiene before slaughter, and post-mortem inspection is described as a primary component of process control in post-slaughter meat hygiene. The CHPM specifically recognises the dual objectives of slaughterhouse inspection activities related to animal and public health outcomes (9).

Efforts to design and implement effective policies aimed at encouraging and optimising integration of animal health and food safety surveillance goals at the slaughterhouse level are logical and strategically sound in theory. However, they encounter a number of logistical, business, financial and scientific impediments, which will be identified. The animal health and food safety data that have been or are being collected through slaughterhouse surveillance, to be discussed in this paper, include records of overt pathology, pathogens, drug residues, chemical contaminants and antimicrobial resistance.

Pathology

Historically, slaughterhouse surveillance has been built around the inspection process: ante-mortem inspection coupled with post-mortem gross and histopathological examination, where indicated. Select in-plant screening tests may supplement inspection at this level, for example:

- tests for antimicrobial residues, e.g. swab test on premises (STOP) (7) and sulfa-on-site (SOS)
- the kidney inhibition swab test (1)
- rapid microscopic examination for certain parasitic pathogens such as *Trichinella*
- rapid serological screening for agents such as *Brucella* spp. (e.g. the card test).

However, veterinarians working in abattoirs in most developed countries today are seldom faced with the presence of gross pathognomonic lesions of such zoonotic pathogens, or visual evidence of toxic agents of animal health and/or food safety importance. Their veterinary diagnostic skills are seldom called into play on site frequently enough to generate meaningful data. The traditional approach does continue to be used in certain developing countries, where gross pathological examination is a key tool for generating animal health and food safety surveillance data.

While inspection of individual carcasses has served well in the past to support focused zoonotic disease eradication programmes in many countries (e.g. brucellosis, bovine tuberculosis), and to deter certain violations related to residues of concern to both animal health and food safety, once these specific goals have been largely achieved, the value of carcass-by-carcass visual inspection or in-plant screening by professional veterinary inspectors is greatly diminished. It is becoming restrictively expensive and inefficient to justify on a continuing basis. With current poultry processing line speeds, it indeed becomes a significant impediment to throughput, if not an impossibility. Surveillance, therefore, has begun more recently to evolve on more divergent and specialised paths to detect animal or human pathogens; the

detection of drug residues, chemicals and antimicrobial resistance, at the slaughterhouse point on the food-production continuum, now requires more sophisticated laboratory analysis and confirmation.

Consequently, some inspection programmes are moving away from policies requiring direct carcass inspection by government veterinarians, to inspection by technically trained primary product inspectors, or industry inspection staff. The veterinarian's role is to verify the competency of the inspection process, confirm the sporadic lesions detected and concentrate on broader oversight of hazard analysis critical control point (HACCP) plans and records, with spot checks at appropriate frequencies. Despite this reality, the daily presence of veterinary inspectors in abattoirs is still a mandatory requirement in certain countries, and thus also for those who export to them.

Pathogens

Many of the current hazards of major concern that have an impact on animal health, and cause associated production losses, are not of concern for food safety, and vice versa. Thus, as discussed above, the great historical strides that have been made in many countries, using classical surveillance through inspection, that achieved the elimination of zoonotic agents such as *Brucella* spp. and *Mycobacterium bovis*, may no longer be relevant in the future in most developed countries. The emergence of bovine spongiform encephalopathy (BSE), however, placed a renewed focus on abattoir surveillance for both animal health and food safety reasons, to ensure the proper removal of identified specified risk materials and the collection of diagnostic materials in support of national surveillance programmes, as there were no ante-mortem tests available for confirmation. With the reduction of the occurrence of BSE in many countries, the current level of slaughterhouse surveillance may not be warranted on an ongoing basis. However, the potential for similar novel or emerging zoonotic pathogens of international importance remains high, and reinforces the continuing relevance of surveillance at the slaughterhouse level for both animal health and food safety reasons.

Thus, the current focus on pathogens at slaughterhouses in developed countries is either specifically on animal health, to detect major causes of production loss (of industry or academic interest), or on exotic pathogens (of government interest), or specifically on major food-safety-related pathogens with animal reservoirs (e.g. *Campylobacter*, *Salmonella*, and human pathogenic *Escherichia coli*), and is less commonly an integrated interest. Emerging confirmed or suspected animal production concerns, such as swine circoviruses, continue to provide support for slaughterhouse surveillance, but such pathogens usually have no known

or suspected food safety consequence. As the presence of most foodborne disease pathogens on intact raw carcasses has historically had little implication for producers, with no premium for their absence or monetary or production-loss penalty for their presence, this has been of limited importance to them. Thus, producers have not invested widely in special measures to reduce their presence.

However, the development of government-led collaborative pathogen reduction initiatives to provide public health outcomes, which are focused around slaughterhouse data collection, establishment of performance targets and public dissemination of results, is directing increased industry attention to these otherwise minor animal health threats. Access to and publication of such slaughterhouse data with associated corporate identification, within such initiatives, may prove effective in encouraging the implementation of pathogen reduction measures, such as the *E. coli* O157:H7 vaccine, where other incentives such as disease reduction, premium product pricing and government subsidies have been absent.

Drug residues

Residues of appropriately licensed drugs may be present in animal tissues at slaughter as a result of inadequate attention on the part of the producer and/or veterinarian in respecting the proper dosage, route of administration and withdrawal time, or in assessing the metabolic impact of the disease for which the drug was administered (11). Occasionally, drugs not licensed for a given species may be present owing to inadequate attention to good practices in applying guidance on extrapolation of withdrawal times for other species in extra-label drug usage. Rarely, drugs banned from animal use in various jurisdictions, such as chloramphenicol, may also be present as a result of illegal black market practices. Surveillance for residues of antimicrobial agents, which constitute a large proportion of all detected residues and include true and semi-synthetic antibiotics as well as chemotherapeutic agents, has historically been performed through a two-step process. First, a qualitative or semi-quantitative biological screening test is conducted in the plant or in regional laboratories. Secondly, a quantitative, generally chromatographic, confirmatory analysis is conducted on samples from carcasses with presumptive positive screening tests. The in-plant qualitative screening is comparatively inexpensive, technically straightforward and has a satisfactory turnaround time consistent with the perishability of the carcass. Non-veterinary administration of drugs or inadequate assessment of the impact of pathology on normal clearance mechanisms can result in detection of extremely high levels of such compounds, which could trigger life-threatening allergic or toxic reactions in consumers, as well as constituting threats to animal health with certain agents such as aminoglycosides. Thus, both

routine sampling for these compounds and targeting of highly suspicious animals based on inspection (e.g. animals with evidence of pneumonia or visible injection sites) typically form the basis of slaughterhouse antimicrobial surveillance programmes.

Increasing concerns about a broader range of pharmaceutical products have necessitated the more routine use of sophisticated chemical analysis by computer-assisted, and typically partially automated, chromatographic methods. The high-profile illegal use of certain beta-agonists, such as clenbuterol, for growth promotion, as well as other growth-enhancing compounds, such as ractopamine, which are not allowed in certain jurisdictions, despite internationally approved standards, has driven demands for greatly expanded drug residue surveillance. Centralisation of such testing for batch processing in sophisticated analytical laboratories, while more resource intensive, does allow the application of multi-residue technologies and efficient sample splitting to facilitate multiple concurrent analyses, to add both scope and efficiency.

Chemical contaminants

Apart from pharmaceutical products, there is an ever-expanding range of chemical contaminants (e.g. heavy metals, pesticides, persistent organic pollutants) to which production animals may be exposed intentionally, or by accident, that have significant potential toxicity and can affect both animal health and food safety. For instance, increasing competition for cheap, spent biomass to generate renewable energy sources, such as bio-diesel, heightens the probability of a major feed contamination event, as occurred in Europe in 2010 with dioxin (4), which has the potential for bioaccumulation. Slaughterhouse data collection was a significant component of the management of that incident.

Additionally, expanding complex global agri-food product markets, and the cost restrictions on routine application of broad sophisticated chemical analysis for detection of adulterants, are setting the stage for increased animal health and food safety threats from economically motivated adulteration (EMA), as occurred with melamine a few years ago. Policies to ensure insightful application of sound business intelligence, to direct selective testing on a risk basis, will be required to minimise undesirable impacts of such unscrupulous activities on both animal health and food safety. This may be best achieved by including such tests in slaughterhouse data collection.

Consequently, most jurisdictions, particularly those exporting foods of animal origin, conduct and publish relatively extensive chemical surveillance programmes for various classes of chemical contaminants. These take advantage of slaughterhouse sample collection, which

provides ease of tracking and collection by inspection staff, so that appropriate follow-up can be carried out if necessary. Transparent policies supporting the public release of collected data, with interpretations and identification of follow-up, are realities of the modern regulatory environment, and are necessary in the management of real and perceived threats to both animal health and food safety.

Antimicrobial resistance

Antimicrobial resistance is an increasing concern in both animal and human health contexts, as pointed out by both the World Health Organization (WHO) and the World Organisation for Animal Health (OIE). Excessive or inappropriate use of antimicrobial products threatens to greatly reduce the efficacy of these powerful tools by contributing to selective pressures that foster the development of acquired resistance in pathogenic species. While the extent to which excessive, inappropriate (or, some would say, any) use in animal husbandry contributes to clinically significant levels of antimicrobial resistance in human pathogens is very controversial, it is likely that it is a significant contributory factor in reducing the value of these drugs for treating human disease. Monitoring for trends in antimicrobial resistance is done at various points along the food continuum, including at the slaughterhouse (10).

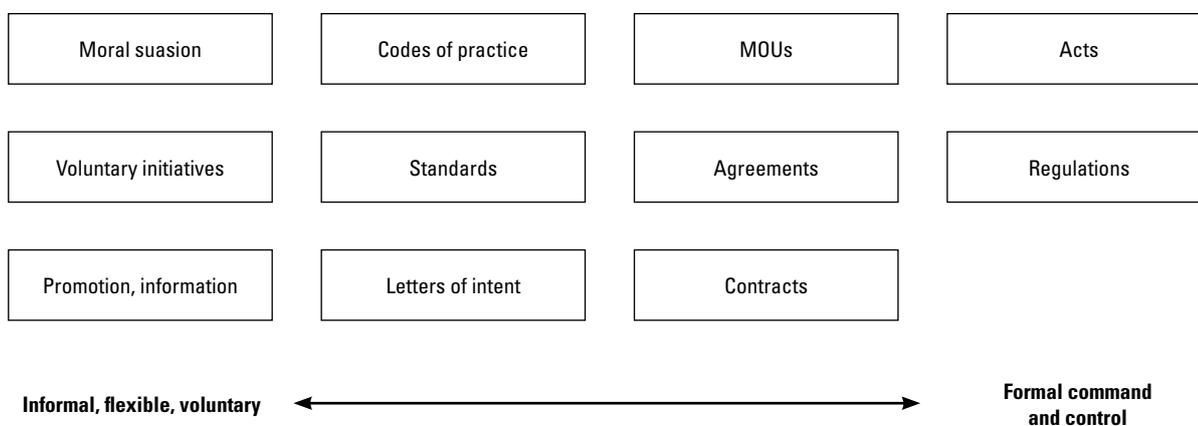
Efforts to design, develop and implement abattoir-based surveillance for antimicrobial resistance on a continuing basis have been more limited than other slaughterhouse surveillance initiatives of significance to both animal health and food safety. In Canada, the Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) (5) has been in continuous operation for ten years. Abattoir-

based sampling is an integral part of this multi-dimensional surveillance system, in addition to farm and retail levels, thus allowing comparative assessments along the food continuum. Given that this programme is carried out as a public health initiative, with leadership from the Public Health Agency of Canada under federal funding, but is delivered on a collaborative basis with other stakeholders, its consistent delivery from year to year is greatly facilitated, without the need for application of more compelling policy tools.

Other global examples of programmes integrating slaughterhouse-level surveillance include the National Antimicrobial Resistance Monitoring System (8) delivered by the United States Food and Drug Administration, the Danish Integrated Antimicrobial Resistance Monitoring and Surveillance Programme (3), and the Colombian Integrated Program for Antimicrobial Resistance Surveillance (2). A wide variety of related programmes that capture human and animal pathogen data and efforts to network them, through the WHO and OIE and others, have been initiated (6).

Policy tools and applications

There are multiple public policy tools that may be applied to initiate, enhance and focus surveillance efforts to better achieve, and benefit from, the integration of animal health and food safety data at the slaughterhouse, as illustrated in Figure 1 (D. Caron, Canadian Food Inspection Agency, personal communication). The selection of appropriate options depends on the most powerful champion of an initiative – government, industry and/or academia – and their methods range from the ‘carrot’ to the ‘stick’.



MOU: memorandum of understanding

Fig. 1

Various policy tools available to achieve surveillance outcomes

The numerous factors to be considered in choosing an instrument include:

- the nature and capacity of the sector
- the risks to be mitigated and the outcomes to be achieved
- available information, and knowledge gaps
- the expertise required internally and externally
- the criteria against which the instruments will be evaluated (e.g. effectiveness in achieving outcomes, efficiency, costs/benefits, international obligations)
- compliance rates
- the ways in which various instruments fit together.

Governments have the ability to compel participation in surveillance programmes through formal but often inflexible legislative or regulatory approaches, but this is a slow, onerous and frequently confrontational approach, which generally requires government to bear the majority of the cost. Voluntary or promotional approaches may be more easily and quickly implemented, but they require a demonstrable benefit to all participants, who at least share the cost, but may not have long-term involvement. Codes of practice and memoranda of understanding (MOUs) typically imply a collaborative cost-sharing approach and a certain level of implied longer-term involvement. All approaches may be applied, but MOUs, agreements or codes of practice often provide the best trade-off and allocation of resources for initiatives such as surveillance.

Industry, acting through association policies and practices, often has the ability to move more quickly than government in implementing policies and programmes, because it is not bound by the same financial and administrative constraints. This can be very advantageous. The industry may also have the ability to exert its influence to obtain financial support and encourage the participation of members through marketing policies that may be as compelling as legislative and regulatory approaches.

Academia has limited policy options or power to drive surveillance initiatives, other than through scientifically grounded moral suasion. However, its ability to attract contributory grant funding, and to allocate fixed resources to address potential issues from a short-term or pilot perspective, greatly enhances its power in areas of interest to government or industry.

On-farm food safety programmes (OFFSPs), biosecurity programmes, and traceability programmes constitute a group of interactive initiatives that have been considered as government-facilitated and industry-implemented policy applications of informal, flexible and voluntary tools in support of both animal health and food safety. To ensure full and uniform application of traceability,

increasing numbers of jurisdictions are making traceability, at least, mandatory through regulatory means, although this typically is designed and implemented with industry cooperation. These measures have the potential to integrate and enhance comprehensive data collection for animal health and/or food safety purposes at the slaughterhouse level. Production records delivered in concert with OFFSPs, biosecurity programme details and traceability systems serve to inform and significantly strengthen the information base for slaughterhouse surveillance.

Ongoing challenges

Efforts to integrate data across diverse organisations such as government, industry and academia to inform critical policy-making processes face significant legal, logistical and financial challenges.

Issues of data ownership, intellectual property and confidentiality, as well as security issues, data formatting and maintenance costs, data access and publication rights, make collaborative efforts complex where multiple partners are involved.

Technical information management and information technology issues present significant considerations and potential obstacles as well. The emergence of wireless handheld devices for in-plant use and so-called ‘cloud’ computing present some exciting options for the management of some of these challenges.

Stable financial support from government, industry and academia is an ongoing challenge, ever at the whim of global economies, as well as the state of the particular industry of focus. The ongoing need for accountability, in order to justify the offsetting public, private and academic benefits of investment in surveillance programmes, must be recognised as an integral part of such surveillance programmes by all parties.

Conclusion

In the current animal production environment in developed countries, the pathogens of major concern for animal health and those for food safety are largely different, i.e. human pathogenic types of *Campylobacter*, *Salmonella* and *E. coli* are not major causes of animal production losses. However, drug residues, chemical contaminants, and antimicrobial resistance are issues of mutual concern, thus supporting efforts at integration. Such issues may have certain specific short-term goals, but predominantly reflect long-term, holistic assessments of the health of animals or the safety of the food supply.

Recommendation one: Where possible, policies to support integration should aim to operate in the long term, to allow more effective trend analysis and assessment of the impact of interventions aimed at reducing overall animal health and food safety risks. Thus, from this perspective, for most integrated animal health and food safety surveillance, government should be the lead or a major partner as it has a long-term mandate, comparatively stable resource base and a more holistic interest across the data categories. Short-term focus areas may be best left to industry and/or academia to manage.

Government's interest is largely aimed at addressing its responsibility to protect the safety of the food supply and identify major threats to the animal resource base from exotic disease, in a cost-efficient manner. Government has access to a broad range of useful policy tools to accomplish these ends, including legislative and regulatory tools. These can trigger financial penalties, or licensing and registration obligations with terms and conditions, and cross-linked compliance promotion obligations, as well as having the ability to exert powerful moral suasion and other softer informal tools.

The interests of industry are largely focused on the economic health of their commodity group and pursuit of competitive advantage. This includes not only consideration of current causes of significant mortality and morbidity, but also, in the longer term, consideration of food safety issues from a perspective of image and brand equity, or even further, in meeting emerging new customer specifications or export requirements. Industry-driven policy levers may in some cases include the implementation of mandatory check-offs to support surveillance, where marketing bodies have such authority, or a variety of voluntary programmes structured either in conjunction with government or independently.

The interests of the academic community in this field are typically project-driven and short-term in nature – related to conducting publication-worthy scholarly research. The policy tools and leverage available to this group are most limited, and are constrained largely to the potential to offer effortless and cost-free or cost-shared information of value to industry as the product of the research efforts. However, academia does have the capacity to develop new surveillance approaches and models capitalising on the recent advances in epidemiology and bio-informatics tools.

Recommendation two: Efforts to promote policies to enhance integration of animal health and food safety surveillance at the slaughterhouse level should aim to integrate a collaborative approach with industry and academia where possible, to pool strengths and leverage costs.

It is clear that the range of potential opportunities for surveillance for animal health and food safety purposes

within each of the categories identified, when aggregated, far exceeds the resources likely to be available through any or all of the proposed proponents individually.

Recommendation three: A sound risk-based planning and review process is required to efficiently optimise the broadest range of sample types and sample analyses within the available resources, according to a risk-prioritised scheme.

With growing consumer and media attention on issues of animal health and welfare, as well as food safety, new public pressures are being exerted on the agri-food industry to confirm that food-producing animals are being raised in a healthful manner and that due diligence in the production of safe food can be demonstrated through efforts such as the Global Food Safety Initiative or other drivers of third-party certification. Although most consumers are not yet willing to pay a differential premium for safer food, major food retailers are increasingly willing to demand that their suppliers absorb the cost of third-party certification of safe food production as part of the cost of entry to their markets.

Recommendation four: Animal health and food safety data at the slaughterhouse level must be transparently available to the public, and must be used to generate regular consumer-oriented communications on the state of animal health and food safety, to reinforce the value of the investment in their generation.

A strong case can be made that the complementary pursuit of sustainable animal health and food safety can in large measure continue to be well aided by surveillance at the slaughterhouse level. The efficiency and the ability to address major threats along the food continuum that this approach offers far outweigh the challenges that it presents. Such an approach does fit very well under the best practice of 'One Health', which integrates key stakeholders from industry producers to processors, government, agencies, academia and consumers to yield superior sustainable animal health and public health outcomes.

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L'intégration des données émanant de la surveillance à l'abattoir de la santé animale et de la sécurité sanitaire des aliments

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Résumé

La surveillance exercée dans les abattoirs à des fins de santé animale et de sécurité sanitaire des aliments consiste à réaliser des examens pour détecter la présence de maladies, d'agents pathogènes, de résidus de médicaments et de contaminants chimiques et à déceler l'apparition de résistances aux agents antimicrobiens. Cette surveillance est préconisée par les gouvernements, ainsi que par le secteur privé et les institutions de recherche. Diverses mesures ou dispositifs volontaires ou réglementaires peuvent être appliqués afin de promouvoir ou d'imposer cette surveillance. Les efforts déployés pour intégrer les données émanant de diverses organisations se heurtent à des difficultés importantes d'ordre juridique, logistique et financier. L'amélioration des mesures de soutien à l'intégration effective des données de la surveillance zoonositaire et de sécurité sanitaire des aliments émanant des inspections conduites dans les abattoirs passe par une approche à long terme, par une collaboration entre les gouvernements, le secteur privé et les institutions de recherche, par l'application d'une méthodologie fondée sur l'évaluation du risque et par un accès transparent du public à ces informations, accompagnées de communications rédigées à l'intention des consommateurs. Il convient d'insister sur le fait que la surveillance exercée au niveau des abattoirs contribue significativement aux objectifs d'amélioration durable de la santé animale et de la sécurité sanitaire des aliments.

Mots-clés

Abattoir – Animal – Denrée alimentaire – Intégration – Politique sanitaire – Santé – Sécurité sanitaire – Surveillance.



Integración de los datos de vigilancia de la sanidad animal y de la inocuidad de los alimentos provenientes del control de mataderos

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Resumen

La vigilancia en los mataderos con fines de sanidad animal e higiene de los alimentos entraña la realización de análisis para detectar la presencia de patologías, patógenos, residuos medicamentosos, contaminantes químicos y resistencias a los antimicrobianos. Los principales promotores de esta labor de vigilancia son los gobiernos, la industria y los medios universitarios. Para fomentar la participación en estas actividades, o para imponerla, se pueden aplicar diferentes políticas e instrumentos normativos, que van desde los voluntarios hasta los de carácter legislativo. Los esfuerzos por integrar los datos en una constelación de entidades tan diversas tropiezan con importantes dificultades jurídicas, logísticas y económicas. La mejora de las políticas para alentar una

integración eficaz de los datos de vigilancia de la sanidad animal y la inocuidad de los alimentos procedentes de las actividades de control de mataderos pasa por promover: un planteamiento a largo plazo; la colaboración entre el sector público, el privado y el universitario; la aplicación de un mecanismo basado en los riesgos; y un acceso público y transparente a los datos, acompañado de comunicaciones destinadas al consumidor elaboradas a partir de esos datos. Todo parece indicar que la vigilancia en los mataderos puede seguir siendo útil para hacer posible a la vez, de forma complementaria y duradera, la sanidad animal y la inocuidad de los alimentos.

Palabras clave

Alimentos – Animal – Integración – Matadero – Política – Salud – Seguridad sanitaria – Vigilancia.



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