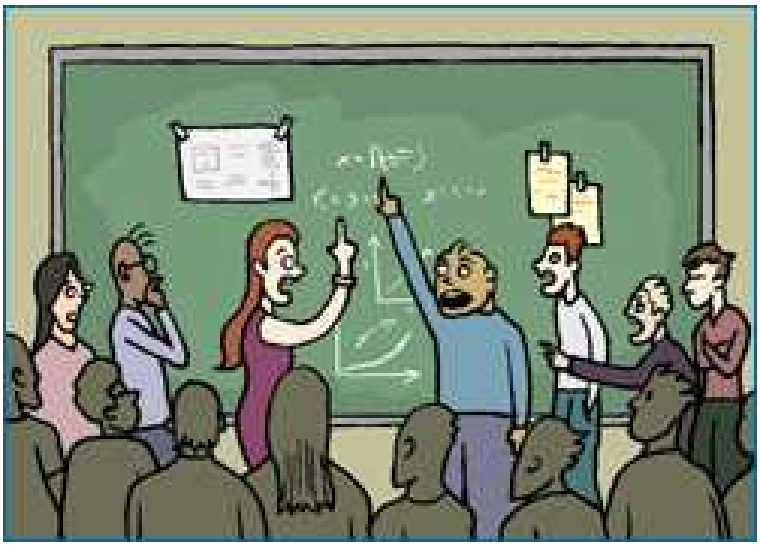
The evolvement of scientific controversies during the Q-fever epidemic

A comparative case study of the Netherlands and Australia



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21 December, 2012

Esmee Kester

Wageningen University – Department of Social Sciences

MSc minor thesis Communication sciences

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Animal sciences

Student: Esmee Kester
Student number: 880710-429-040

Quantitative Veterinary Epidemiology

Supervisor: Severine van Bommel

COM 80424

Source illustration cover: http://undsci.berkeley.edu/article/0_0_0/sciencetoolkit_06

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Summary

Q-fever is a zoonotic disease caused by the bacteria *Coxiella burnetii.* In the Netherlands it is most commonly seen and known in sheep, cattle and goats. The bacteria is shed by infected animals in their body fluids like saliva, urine, milk, placenta and amniotic fluid. Humans get infected in most cases by inhalation of the bacteria that can be transported across long distances by dust. During the epidemic in the Netherlands which lasted from 2007 to 2010, Q-fever showed to be a serious risk for public health. Since 2007 there are already 4173 reported cases of *Coxiella burnetii* infections in humans. There are 25 reported cases of deaths. During and after the outbreak national and international critique about the approach was expressed, primarily in the media. At the beginning it was already detected that a lot of scientific information about the disease was missing. Foreign knowledge that was there, could hardly be used because the epidemic was referred to as an internationally unique situation and thus did almost not corresponded to the occurrence of Q-fever in other countries. As a result important decisions were not always based on scientific information about Q-fever.

Because science is according to the traditional view often seen as a credible and reliable source, it is used by the government in decision-making. If there is scientific proof, we are much more eager to believe it and act on it. However, in practice the role of science in decision-making will not always work as intended, and as a result, scientific controversies can occur. The aim of this study was therefore to understand the evolvement of scientific controversies that arose during the Q-fever outbreak in the Netherlands. Another aim was to provide guidance for how to handle controversies in policy and decision-making processes. These scientific controversies can be studied by describing boundaries in science. The boundary between science disciplines is described as a demarcation drawn by scientists as a strategic action in an attempt to protect their interests. By demarcating their work they try to gain credibility, legitimacy and epistemic authority. Because boundary work is seen as a controversy between groups, describing boundary work in science provides more grip on controversy. Boundary work has a demarcating function that can work by different strategies as conflict escalation, and a coordinating function that can work as conflict de-escalation. Concerning the consequences a scientific controversy that escalates can be quite damaging. Therefore the boundary work in scientific controversies was identified in the epidemic. To do this a literature study has been carried out and interviews were held with people that were involved in the decision-making process of Q-fever. Besides that, transcribed results of hearings that were presented in the study of the 'Nationale ombudsman' were also included in the analysis. Because special attention was given to international controversies, a comparison has been made between the problem of Q-fever in the Dutch situation and the Australian situation. This showed that boundary work in the Netherlands is already integrated in the national approach of infectious diseases. The political and science side are clearly separated so the focus is entirely on substance or feasibility. This corresponds to a neo-institutional approach where the policy and science side are separated by a powerful demarcation and where sides have specific labour and interact in certain patterns. In Australia such separation is also visible but there are more commissions involved here, each with their own tasks. It appeared that boundary work in Australia had a stronger coordinating function than in the Netherlands. Besides this difference, it also showed that the problem of Q-fever was seen and represented differently in the Netherlands than in Australia. In the Netherlands it is seen as a public health problem, while it is an occupational hazard in Australia. Such different problem representations have led to different ways of thinking and a dividing function of clear boundary work. This resulted into scientific controversies that by the so-called expulsion strategy and the strategy of the protection of autonomy escalated on an international meeting.

In the prevention of conflict escalation it is important to know that it does not always have to be avoided. Only escalation above some intensity will be damaging and therefore should

be avoided. First of al, it is important to be aware of the situation going on. Secondly, in conflicts boundary work can have next to the dividing function a coordinating function as conflict de-escalation. Besides these de-escalation possibilities and when looking back on the Q-fever case, the prevention of conflict escalation in subsequent outbreaks logically also involves the creation of mutual understanding of the specific problem in the concerning country. International meetings demonstrated to be important for such understanding by sharing data, specific problem situations and advice. When such meetings were organised more regularly during the Q-fever outbreak and thus foreign experts were more strongly involved, a better understanding of the disease and the influence of differences in countries would probably have been created. Boundary work would possibly not have worked then as dividing but only coordinative. Subsequently this maybe could have led to a better cooperation and more useful foreign advices on the management of the disease. This may be advantageous in any subsequent outbreak and in this way scientific controversies can perhaps be handled better.

Samenvatting

Q-koorts is een zoönose die veroorzaakt wordt door de bacterie *Coxiella burnetii.* In Nederland wordt de ziekte het meest gezien en is ook het bekendst bij schapen, runderen en geiten. De bacterie wordt door geïnfecteerde dieren uitgescheiden in lichaamsvloeistoffen zoals speeksel, urine, melk, placenta en vruchtwatervloeistof. Mensen worden meestal geïnfecteerd door het inademen van de bacterie die met stof over lange afstanden kan worden getransporteerd. Tijdens de epidemie in Nederland die van 2007 tot 2010 duurde, bleek Q-koorts een groot gevaar te zijn voor de volksgezondheid. Sinds 2007 zijn er al 4173 gevallen van humane *Coxiella burnetii* infecties bekend. Al 25 mensen zijn hieraan overleden. Tijdens en na deze uitbraak is er vooral in de media nationale en internationale kritiek geuit over de aanpak van de ziekte. Aan het begin van de epidemie was het al bekend dat er weinig wetenschappelijke kennis beschikbaar was over de ziekte. De buitenlandse kennis die er was, kon bijna niet worden gebruikt omdat de uitbraak in Nederland als uniek werd beschreven en dus nagenoeg niet overeen kwam met hoe Q-koorts in andere landen voorkwam. Hierdoor zijn belangrijke beslissingen in de aanpak van de ziekte niet altijd direct gebaseerd geweest op wetenschappelijke kennis over Q-koorts.

Omdat wetenschap volgens de traditionele visie gezien wordt als een geloofwaardige en betrouwbare bron, wordt het gebruikt in de besluitvorming van de overheid. Als ergens wetenschappelijk bewijs voor is, willen we dit graag geloven en handelen we ook daarnaar. Echter, in de praktijk werkt de rol van wetenschap in de besluitvorming niet altijd zoals het bedoeld is. Dit kan dan resulteren in wetenschappelijke controversen. Het doel van dit onderzoek was daarom om de ontwikkeling van wetenschappelijke controversen te begrijpen die ontstonden tijdens de Q-koorts uitbraak in Nederland. Daarnaast was het de bedoeling een leidraad te bieden voor het omgaan met controversen in de politiek en besluitvormingsprocessen. Deze wetenschappelijke controversen kunnen worden bestudeerd door de constructie van grenzen (ofwel grenzenwerk) in de wetenschap te beschrijven. Deze wetenschapsgrenzen zijn beschreven als een strategische afbakening die door wetenschappers gecreëerd zijn, in een poging hun belangen te beschermen. Door deze afbakening van hun werk proberen zij geloofwaardigheid, legitimiteit en epistemische autoriteit te verkrijgen. Omdat het construeren van zulke grenzen wordt gezien als een controverse, geeft het beschrijven van deze grenzen in de wetenschap meer grip op zo'n conflict. Het creëren van grenzen heeft een afbakenende functie die door verschillende strategieën als conflictescalatie kan werken, en het heeft een coördinerende functie die juist als conflictde-escalatie kan werken. Gezien de consequenties kan de escalatie van een wetenschappelijke controverse erg schadelijk zijn. Daarom zijn de constructies van grenzen in de wetenschappelijke controversen van de epidemie geïdentificeerd. Hiervoor is een literatuurstudie uitgevoerd en zijn mensen geïnterviewd die betrokken waren bij de besluitvorming van Q-koorts. Daarnaast zijn ook getranscribeerde resultaten van de hoorzittingen uit het onderzoek van de Nationale ombudsman in de analyse betrokken. Omdat er vooral gefocust is op internationale controversen is er een vergelijking geschetst van het probleem van Q-koorts in Nederland en in Australië. Hieruit bleek onder andere dat het construeren van grenzen in Nederland al geïntegreerd zit in de nationale aanpak van infectieuze ziekten. De politieke en wetenschappelijke kant zijn namelijk duidelijk van elkaar gescheiden om een optimale besluitvorming te garanderen. Dit wordt ook wel als een neoninstitutionele aanpak beschreven waarin de politiek van de wetenschap is gescheiden door een sterke grens en waarbij beide kanten specifieke taken hebben en in bepaalde patronen op elkaar inwerken. In Australië is zo'n scheiding ook zichtbaar maar zijn er meerdere commissies betrokken in dit proces die ieder hun eigen taken uitvoeren. Het bleek dat het grenzenwerk in Australië een sterker coördinerende functie had dan in Nederland. Naast dit verschil bleek ook dat het probleem van Q-koorts in Nederland anders gezien en gerepresenteerd wordt dan in Australië. In Nederland wordt het als een gezondheidsprobleem gezien, terwijl het in

Australië meer een beroepsrisico is. Zulke verschillende probleem representaties leidden tot verschillende denkwijzen en tot de afbakenende functie van het construeren van duidelijke grenzen. Dit resulteerde in wetenschappelijke controversen die uiteindelijk door de zogenaamde verdrijvingstrategie en de strategie van het beschermen van de autonomie op een internationale bijeenkomst escaleerden.

Bij de preventie van conflict escalatie is het belangrijk om te weten dat dit niet altijd hoeft te worden vermeden. Escalatie is alleen nadelig wanneer het boven een bepaalde intensiteit komt en dan zal dit moeten worden voorkomen. Ten eerste is het daarnaast belangrijk om bewust te zijn van een bepaalde situatie. Ten tweede kan in conflicten het grenzenwerk naast een afbakenende functie, een coördinerende functie hebben. Naast deze de-escalatie mogelijkheden en terugkijkend op de epidemie, houdt de preventie van conflictescalatie bij volgende uitbraken in dat er wederzijds begrip moet worden gecreëerd voor een specifiek probleem in een betreffend land. Internationale bijeenkomsten zijn juist belangrijk voor het uitwisselen van gegevens, specifieke probleemsituaties en advies. Als zij vaker waren georganiseerd tijdens de Q-koorts uitbraak en dus als buitenlandse experts sterker waren betrokken, was er waarschijnlijk een beter begrip rondom de ziekte en de invloed van de landsverschillen ontstaan. Grenzenwerk had dan ook niet als afbakenend maar meer als coördinerend gefunctioneerd. Dit had dan mogelijk geleid tot een betere samenwerking en meer bruikbaar buitenlands advies op de aanpak van de ziekte. Dit kan voordelig werken in volgende uitbraken en zo kan er wellicht ook beter met wetenschappelijke controversen worden omgegaan.

Preface

This thesis is written as a completion of the minor part of the Master program at the Wageningen University.

This Master program consists of two parts. The major part of the study is Quantitative Veterinary Epidemiology. The minor part is Communication science. To integrate the section of animal diseases into communication, a topic on communication at the time of a disease outbreak was chosen. The Q-fever outbreak in the Netherlands showed to be a great example because of its controversy and recency. The research focussed on scientific controversy at the outbreak and also on the international representation of Q-fever. Performing such a qualitative study was a whole new competence and accomplishment for me. There were more differences with quantitative research than it seemed at first sight. This eventually led to personal development and made the research from beginning to end a true experience.

I would like to take this opportunity to thank my supervisor Dr. Severine van Bommel, for her guidance, advice and valuable comments on my work. At every meeting her positivism and confidence in my research contributed greatly to the result. Also I would like to thank the people from the ministry of EL&I, GGD, RIVM, NVWA and CVI, for their cooperation, openness and helpfulness. Without their help this thesis could not be completed. Lastly, I would like to thank my family and friends for their interest, encouragement and support.

Esmee Kester
December, 2012.

Abbreviations

Listed below are the abbreviations that are used throughout the report. They can be Dutch or English. Dutch abbreviations are also presented with an English explanation.

ACVO	Australian Chief Veterinary Officer
AHMAC	Australian Health Ministers' Advisory Council
AHC	Animal Health Committee
AHPC	Australian Health Protection Committee
BAO	Bestuurlijk AfstemmingsOverleg (administrative coordination meeting)
CCEAD	Consultative Committee on Emergency Animal Diseases
CDC	Centre for Disease Control and Prevention
CDNA	Communicable Diseases Network Australia
CIb	Centrum Infectiebestrijding (centre for infectious disease control)
CMO	Chief Medical Officer
CVI	Centraal Veterinair Instituut (central veterinary institute)
CVO	Chief Veterinary Officer
DAFF	Department of Agriculture, Fisheries and Forestry
DG	Directeur Generaal (Director General)
DoHA	Department of Health and Ageing
EADRA	Emergency Animal Disease Responses
ECDC	European Centre for Disease Prevention and Control
EFSA	European Food Safety Authority
ELI	Ministerie van Economische zaken, Landbouw en Innovatie (Ministry of economic affairs, agriculture and innovation) formerly called Ministerie van Landbouw, Natuur en Voedselkwaliteit (Agriculture, Nature and Food quality)
ELISA	Enzyme-Linked ImmunoSorbent Assay
GD	Gezondheidsdienst voor Dieren (animal health service)
GGD	Gemeentelijke GezondheidsDienst (MHS Municipal Health Service/Regional Health Department)

GHOR	Geneeskundige Hulp bij Ongevallen en Rampen (medical assistance in accidents and disasters)
HvB	Hart voor Brabant (heart for Brabant)
IFT	Indirect Immunofluorescence Test
LCI	Landelijke Coördinatie Infectieziektebestrijding (national coordination structure for infectious disease control)
LNV	Ministerie van Landbouw, Natuur en Voedselkwaliteit (Agriculture, Nature and Food quality) Former EL&I
LTO	Land- en Tuinbouw Organisatie Nederland (agri- and horticulture organisation the Netherlands)
LZO	Laboratorium voor Zoönosen en Omgevingsmicrobiologie (laboratory for zoonoses and environment microbiology)
NCIRS	National Centre for Immunisation Research and Surveillance of Vaccine Preventable Diseases
NMG	National Emergency Animal Disease Management Group
NVWA	Nederlandse Voedsel en Waren Autoriteit (Dutch food and consumer product safety authority)
OIE	World Organisation for Animal Health
OHP	Office of Health Protection
OMT	Outbreak Management Team
OMT-z	Outbreak Management Team – Zoonoses
PCR	Polymerase Chain Reaction
PIMC	Primary Industries Ministerial Council
PISC	Primary Industries Standing Committee
PvdD	Partij voor de Dieren (party for the animals)
QUAGOL	Qualitative Analysis Guide of Leuven
RIVM	RijksInstituut voor Volksgezondheid en Milieu (national institute for public health and the environment)
VIC	Veterinair Incidenten- en Crisiscentrum (veterinary incidents and crisis centre)
VWS	Ministerie van Volksgezondheid, Welzijn en Sport (Ministry of public health, welfare and sport)
WHO	World Health Organisation
WUR	Wageningen University and Research centre

Contents

Tables and figures

1. Introduction

In the Netherlands we regularly have to face a zoonosis outbreak. Among other diseases, we already have dealt with avian influenza, MRSA and BSE. A zoonosis is a disease that can be transmitted from animals to humans or the other way around. Because of this, risks may occur on different levels during an outbreak. Symptoms in animals affect animal welfare, a reduced production results in economic loss for the farmer, and if symptoms in humans appear, public health is threatened. This makes it often hard to take decisions about measures that prevent the disease from spreading. To make such decisions, sufficient facts and information about the disease are necessary. A recent example of a multilevel zoonotic disease involving a difficult decision-making process, is Q fever. Q-fever resulted into consequences on economic level, animal welfare and public health levels when it reached epidemic proportions in 2007-2010 in the Netherlands. During and after the outbreak national and international critique about the decision-making was widely reported in the news. Van Dijk et al (2010) noted that one of the problems was that there was a lot of missing scientific information on the disease. Besides that, the problem was from the Netherlands referred to as an internationally unique situation. As a result, important decisions during the Dutch Q-fever problem were not always based on scientific information that it would reduce the spread of Q-fever (van Dijk et al, 2010). This led me to wonder about the role of the problem of Q-fever internationally, science in political conflicts, and the process behind imposed measures.

1.1 Science in policy

According to the traditional view on science or critical model, facts and information are provided by science. Science is often seen as a credible and reliable source. If there is scientific proof, we are much more eager to believe and act on it. Uncertainties arise when there is more than one scientific claim (Gieryn, 1999). Turnhout (2003) presents two models that describe the relationship between science and policy. The knowledge utilization model assumes a strong demarcation between science and policy. Both domains pursue different goals and have other responsibilities. Too much interference of science in policy will lead to technocracy. The coproduction model on the other hand assumes a dynamical interaction between science and policy. There is joint and close cooperation. Scientific information is here seen as a social construction. In contrast to the knowledge utilization model, facts and values are not being used to separate science from policy but the demarcation is drawn in every situation in different ways and thus is context specific. The demarcations in the coproduction model are called boundary work (Turnhout, 2003). Following these models in policy, science is in the form of objective, credible and scientifically established facts needed to reduce and close debate so that evidence-based decisions can be made (Turnhout et al, 2007). It is thought that an evidence-based decision achieves a higher likelihood of success (Brownson et al, 2009). However, in practice scientific knowledge is often used by parties to legitimize their interests. According to literature it is therefore frequently applied as a strategy or tactic in ideological debates (Pielke, 2007). Collingridge and Reeves (1986) refer to such situations by the under critical model and the over critical model. The under critical model describes the situation where facts are accepted and fits with already existing opinions and interests (Collingridge and Reeve, 1986). There can be also situations where scientific knowledge does not lead to reducing and closing debates but just to more debates about for example the data or interpretation of this new knowledge (Turnhout et al, 2007). When this happens scientific knowledge does not fit with the opinions and interests and scientific controversy occurs. Debates are endless and the knowledge will be rejected. This situation is called the overcritical model (Collingridge and Reeve, 1986).

1.2 Scientific controversies and their effects

In the occurrence of scientific controversy, the contribution of science in solving political conflicts may be disappointing. This is mainly due to the fact that boundaries between politics and policy are not clear and sometimes difficult to distinguish (Pielke, 2007). The use of science in solving a policy problem involves power. First of all, there can be an excess of objectivity. Scientific experts on each side of the parties can neutralize each other. Now scientific knowledge has no influence anymore so the more powerful political or economic interests will predominate (Pielke, 2007). A second reason why science may be disappointing in solving a political conflict is that some politicians are convinced that scientists on their side produce facts and are credible, while scientists on the other side produce untrue facts just to justify their actions. This can result in a pseudo-debate, where only power, privilege and profit are important (Ravetz, 2006). As a result some authors think that the integrity of scientists has been compromised these days (Ravetz, 2006).

As has been discussed the role of science in decision-making will not always work as intended. This is also recognizable in decision-making in the Q-fever case. There were ongoing debates, ethics were involved, and scientific information was largely missing. This resulted in scientific controversies and as we have seen scientific controversies can potentially be quite damaging when they escalate. There is little insight yet into the evolvement of scientific controversies. This research will contribute to this debate in literature by providing insight into the decision-making process in the Q-fever case. The process of the evolvement of scientific controversies will be central.

1.3 Research objectives and structure of the thesis

Many reports have already been published concerning issues on the Q-fever case, and many are still ongoing. This thesis will focus on the process behind the imposed measures during the outbreak. The aim of the thesis is to understand the evolvement of scientific controversy during the Q-fever outbreak in the Netherlands. Another aim is to provide guidance for how to handle controversies in policy and decision-making processes. Specific attention will be paid to international controversies. Therefore the thesis is composed of information on the Dutch Q-fever case and Q-fever in Australia, where this problem appears to be different. This is obtained by a literature study and a field research. A comparative analysis will indicate the differences in problem representation and how these were expressed, misunderstood and finally how these escalated or de-escalated. The result of the analysis will lead to a better understanding of the evolvement of scientific controversies and provides guidance for how to handle the controversies in policy and decision-making processes.

To explain the topic more in detail the next chapter elaborates different elements which resulted in the formation of a research question. The tools and techniques that are used to find answers for the research question and sub-questions are described in chapter 3. Chapter 4 and 5 present the results from the literature study and field research. These are referred to as the Dutch case study and the Australian case study. The comparative analysis is described in chapter 6. The conclusion and discussion are described respectively in chapters 7 and 8.

2. Theoretical framework

In the decision-making process of zoonoses many organizations are involved. They interact with each other over a certain period. During this period many things happen besides only making decisions. Each organisation represents other interests and in the process of decision-making conflicts and relationships change. This chapter provides a closer look towards scientific controversies and how the evolvement can be studied.

2.1 Scientific controversies

Controversies arise when one party disagrees with another party (Hines, 2001). Two sides can claim the authority of science and believe that the other one is wrong. There are always many people actively engaged in the research because it concerns a sustained debate within the broader scientific community. To be scientifically controversial the topic should be taken serious and is continuing about the difference of belief (Mc Mullin, 1987). This is what distinguishes scientific issues from ethical issues. Ethical problems are based on disagreement in attitude. Scientific problems are based on disagreement in belief (Boisvert, 2011). This difference is also described by Hines, who presented 3 types of scientific controversies; decisional controversies (taking action despite inadequate information), ethical controversies (issue is part of morality, ethics, or preferences), and informational controversies (unknown is expected to be elucidated by further research). A topic can include more than 1 type of controversy, but are all solved in a different way. Informational controversies are solved by additional information, so time will tell the truth. Ethical and decisional controversies depend on other factors. Here the underlying issues must be addressed more openly to be solved. Pielke (2007) describes ethical issues on the basis of abortion politics. The ethical situation is characterized by emotion, rationalization, power and selection. Decisions will not remain only scientifically based but are power based, and information will be used to convince others (Pielke, 2007). Scientific controversy, either ethical, decisional or informational, becomes a problem when the desire for the truth evolves faster than facts can clarify an issue or when facts are uncertain. At some point people want to know the truth or information is needed to take adequate measures in order to, for example prevent a disease from spreading (Hines, 2001).

2.2 Boundaries in science

Scientific controversies can be studied by describing boundaries in science. Boundary work is described by people that claim some epistemic authority in the name of science (Gieryn, 1999). The boundary between scientific disciplines is described as a demarcation drawn by scientists as a strategic action in an attempt to protect their interests. By demarcating their work they try to gain credibility, legitimacy and epistemic authority (Gieryn, 1999; Metze, 2009). When boundaries are contested this can lead to a scientific controversy.

Nowadays boundary work is described by two approaches. In the first approach the demarcations of the boundaries around science are described as a dominant discourse. In the discursive mechanism to empower science it has been shown that scientists aimed at a monopoly position by using argumentation. It is assumed that authority, legitimacy and credibility of demarcations are negotiated. This is renegotiated every time, so also situations could occur where the demarcations of politics are more authoritative, credible and legitimate (Metze, 2008). In the neo-institutional approach demarcations are described powerful due to specific relationships between experts, policy makers and their organisations. Because of specific institutionalized boundary arrangements there is a power division between science and politics. Both sides are separated by specific labour and interact in certain patterns (Metze, 2009). Social conventions, culture and regulatory

styles are important factors in the institutionalisation of boundaries between politics and science (Metze, 2008).
The functions of boundary work are described by Halffman (2003). He describes boundary work as both dividing and coordinating. By protecting against interference, while trying to ascribe proper ways of behaviour for participants and non-participants, boundary work is dividing. By defining proper ways for interaction and making this interaction possible and conceivable, boundary work is coordinating (Halffman, 2003). Since boundary work is seen as a controversy between groups, describing boundary work in science provides more grip on controversy. The demarcating function of boundary work can work as conflict escalation and the coordinating function as conflict de-escalation. To indicate how situations lead to escalation or de-escalation and thus how scientific controversy evolves, theories of conflict and conflict escalation will be used.

2.3 Conflict

One of the definitions of conflicts in general is described by Pondy (1966) as:

"The disagreement or perception of disagreement between two persons on some choice or preference; or as the inability to resolve such disagreement or merely as incompatibilities among several formally defined jobs" (Pondy, 1966, p.246).

Pondy presents conflict as a dynamic process, taking place within a period of time. He describes it as a sequence of conflict episodes. Each episode starts with certain observable characteristics and ends with an aftermath that influences the next episodes (Pondy, 1967). Glasl (1999) indicates that every conflict is based on differences, but it really comes to a conflict when other items are added. At least '*action*' and '*perceived effects*' must be included. '*Action*' represents behaviour of an actor and '*perceived effects*' represents how this behaviour is perceived by the other actor. Walker and Daniels (1997) on their side collected a lot of specific and less specific definitions of conflicts. All these descriptions make it difficult to present one single definition of conflict. At the same time there are some common shared characteristics about conflicts. These include the words disagreement, belief, goal, interdependence and incompatibility. Walker and Daniels (1997) made an extended classification of the possibilities to conflict. The nature of incompatibilities can be fact-based (what is true), value-based (what should be the determinants in issues), interest-based (who will get what in distribution of scarce resources), jurisdiction-based (who has authority), person-based (personality issues) and history-based (related to history of issues) (Walker and Daniels, 1997).

2.4 Escalation of conflict

Escalation of a conflict is described by Wall and Callister (1995) simply as the process of increased intensity or worsening of the conflict. Pruitt and Rubin (1986) described escalation as a process whereby tactics go from light to heavy, issues proliferate, parties become increasingly absorbed in the struggle, and goals change from self-advancement to subverting the adversary. Pondy (1967) described five stages of a conflict episode. The first stage is called latent conflict, here possibilities exist for a conflict to take place. The perceived (second) conflict stage can exist when no latent conflict conditions may be present, so actors in conflict are aware that there are issues. The relationship between two parties is not affected. In felt (third) conflict stage the relationship is affected between the two parties due to conflict. In manifest (fourth) conflict behaviour that goes with conflict (like aggression) is shown. In this stage escalation of the conflict occurs. In the last stage, the conflict aftermath, conflicts are resolved. The way conflicts are resolved affects the relationship of the parties and the next episode of conflict (Pondy, 1967).
Another model to identify the intensity level of conflict is the escalation model described by Glasl (1997). He describes a nine-stage model, presented in table 1, for the development of conflict with clear and distinctive thresholds for each level.

Table 1. Conflict escalation model. (Adopted from Glasl, 1997)

Stage	**Conflict issues**	**Behavioural norms**	**In-group/out-group cognitions and attitudes**	**Treshold to next level**
1. "Hardening"	Objective issues Hardening standpoints	Straight argumentation	Awareness of mutual dependence Nascent role expectations Nascent in-/out-group formation, "skins" form around groups Suspicions about hidden motives	Tactical tricks used in the argumentation
2. "Debates and polemics"	Objective issues and relative position, superiority Ability to influence	Verbal confrontations Tactical feints in argumentation Debates	Affinity inwards Fixation at standpoints Ambivalence cooperation/ competition Suspiciousness Counterpart has "typical behaviour"	Action without consultation
3. "Actions, not words"	Objective issues and self-image Freedom of action Prove one's own mastery Blocking the counterpart	Action without consultation Accomplished facts Symbolic behaviour (jargon) Decreased verbal communication - increased non-verbal communication Extended social arena	Blocked empathy "Counterpart not capable of development" In-group conformity pressure	"Deniable punishment behaviour" Covert attacks directly aimed at identity of counterpart
4. "Images and coalitions"	Counterpart is the problem Win or lose Save reputation	"Deniable punishment behaviour" Exploitation of gaps in norms Formation of coalitions Attacks on core identity	Dual cognition (black/white) Coherent enemy image Attribution of collective characteristics to counterpart Self-image as only reacting to counterpart	Loss of face

5. "Loss of face"	Fundamental values Expose counterpart Rehabilitate dignity	Attacks on the public face of the counterpart Restore prestige	Enemy "unmasked": perceived as morally corrupt Guilt symbiosis in-group	Ultimatum Strategic threats
6. "Strategies of threats"	Control of counterpart	Presentation of ultimata Panic-ruled actions Self-binding statements Extension of conflict	Own actions are only reactions Perceived impotence –> rage Need for control	Execution of ultimata Attacks on counterparts sanction potential
7. "Limited destructive blows"	Hurt counterpart more than one's own group Nothing to gain Survival	Attacks at sanction potential Threats + interrupted communication	Counterpart prepared to do anything Counterpart not human Power-thinking dominates Malice important motive	Attacks at core of enemy Effort to shatter enemy
8. "Fragmentation of the enemy"	Annihilate counterpart Survival	Attacks at vital functions Actions to shatter counterpart Attacks on cohesive function	Annihilation fantasies Fascination with mechanical annihilation mechanisms	Giving up self-preservation Total war
9. "Together into the abyss"	Annihilation at any cost	Total war with all means Limitless violence	Accept one's own destruction if counterpart is destroyed	–

The nine-stage model is comprehensive, clear, thorough and has distinctive thresholds for each level. Every step describes the emotional, psychological and behaviour reaction of that situation. Because escalation goes 'deeper and deeper' Glasl describes the escalation as a downward movement. The last column (threshold) indicates that people are about to cross over to the next level of escalation. Understanding of the escalation level can be useful for example to make actors involved in conflict aware where they are positioned in their conflict. They can decide to put more or less resources into conflict and they can also see if going into the next level will yield more cost or benefit. Another purpose is that they can make a better judgement whether they need outside help (e.g. mediators) (Glasl, 1997). This model contributes to provide insight into the understanding of the evolvement of the conflict of scientific controversy. The model of Glasl is one of the most complete escalation models that was find so far, this is why it will be used as a guideline to describe the process of conflict escalation in the Q-fever case.

For a conflict to escalate there are three strategies known. The first strategy is expulsion, in this case there is rivalry between two scientific sources. The monopoly position remains on the science side as boundary-work also remains a social control. Both sides try to legitimate their ideas by making it as scientifically as possible. The second strategy is expansion. Here rivalry exists between two or more epistemic authorities that are

trying to extend their frontiers by jurisdictional control. The third strategy is protection of autonomy. It is used to exploit the epistemic authority in ways that compromise the resources of other scientists. Scientists do this for example to protect their professional autonomy (Gieryn, 1999).
For a conflict to de-escalate, Pondy (1967) described three different models. These models aim to resolve a conflict. The first model is the bargaining model, this is used when there is a conflict among interest groups about scarce resources. The second is the bureaucratic model, which is used in superior-subordinate conflicts. The third model is the systems model, which refers to lateral conflict. This is used when there is a conflict among parties to a functional relationship.

2.5 Research question

In order to provide guidance for how to handle scientific controversies in policy and decision-making processes, the literature described above leads to the corresponding central question:
How did scientific controversies evolve during the Q-fever outbreak in the Netherlands?

This question will be addressed through the following sub-questions:
1. What kind of boundary work can we observe?
2. How did the conflict escalate or de-escalate?
3. What kind of strategies led to this?

3. Methods

This chapter presents the tools and techniques that are used to carry out the thesis. The following paragraphs discusses the design, the research strategy, data collection techniques and data analysis.

3.1 Design

The topic explained in previous chapters have resulted into an interpretive research design. The purpose of interpretive research is to seek for reasons or meanings for a particular phenomenon (Haverland and Yanow, 2012). In the thesis the focus is on the decision-making process during the Q-fever outbreak in the Netherlands. This issue is explored in depth and in context. A detailed understanding of social or organizational processes was needed. This is why the strategy for the qualitative research is in the form of a case study (Heartley, 2004). It is known that case studies are particularly used when a problem or situation must be understood (Noor, 2008), so we have to learn from that particular case (Stake, 1995), and also when 'how' or 'when' questions are being posed (Kohlbacher, 2006). Stake (1995) describes that you use a case study when the case itself is of very special interest. He defines this further as;

"Case study is the study of the particularity and complexity of a single case, coming to understand its activity within important circumstances" (Stake, 1995, p.xi).

When performing a case study it is important to notice that case studies in positivists research and in interpretive research are not the same. The difference gets unclear when interpretive researchers are working with positivists work in support of their methods. When the explanation of case selection criteria is based on positivists work it gets even more confusing. Interpretive research is mostly characterized by research on processes or meanings, while positivists research principally tries to identify causes that explain the studied event. Therefore positivists research starts with hypotheses, variables and specific concepts and theories, while interpretive research does not. Specificity may work as limiting in interpretive studies. In positivists case studies it is already clear what the entity studied is a case of and in interpretive case studies this is not clear yet and has to be found out (Haverland and Yanow, 2012). Because a case study focuses deeply on a particular event, issue, process, feature or unit of analysis, it is able to use many sources of evidence and captures changes in situations (Noor, 2008). The case for this study was to understand the evolvement of scientific controversies during the Q-fever epidemic. To understand the international controversy the case study of Q-fever in the Netherlands was compared to the case study of Q-fever in Australia.

3.2 Type of case study

There are different categories of case studies. It depends on the type of research question, extent of control of the investigator, and the degree of focus on contemporary if a case study is an explanatory, exploratory or descriptive one (Kohlbacher, 2006). Often no particular choice is made between the type of case study, but the methods are different (Stake, 1995). Further division in case studies are made by Baxter and Jack (2008) based on Yin (2003) and Stake (1995). Definitions of these types are presented below in table 2.

Table 2. Case study types. (Adapted from Baxter and Jack (2008) with alterations of Noor (2008))

Case Study Type	**Definition**
Explanatory	This type of case study would be used if you were seeking to answer a question that sought to explain the presumed causal links in real-life interventions that are too complex for the survey or experimental strategies. In evaluation language, the explanations would link program implementation with program effects (Yin, 2003).
Exploratory	This type of case study explores those situations in which the intervention being evaluated has no clear, single set of outcomes (Yin, 2003). It is used for formulating questions or hypothesis testing (Noor, 2008).
Descriptive	This type of case study is used to describe an intervention or phenomenon and the real-life context in which it occurred (Yin, 2003).
Multiple-case studies	A multiple case study enables the researcher to explore differences within and between cases. The goal is to replicate findings across cases. Because comparisons will be drawn, it is imperative that the cases are chosen carefully so that the researcher can predict similar results across cases, or predict contrasting results based on a theory (Yin, 2003).
Intrinsic	Stake (1995) uses the term intrinsic and suggests that researchers who have a genuine interest in the case should use this approach when the intent is to better understand the case. It is not undertaken primarily because the case represents other cases or because it illustrates a particular trait or problem, but because in all its particularity and ordinariness, the case itself is of interest. The purpose is NOT to come to understand some abstract construct or generic phenomenon. The purpose is NOT to build theory (although that is an option; Stake, 1995).
Instrumental	Is used to accomplish something other than understanding a particular situation. It provides insight into an issue or helps to refine a theory. The case is of secondary interest; it plays a supportive role, facilitating our understanding of something else. The case is often looked at in depth, its contexts scrutinized, its ordinary activities detailed, and because it helps the researcher pursue the external interest. The case may or may not be seen as typical of other cases (Stake, 1995).
Collective	Collective case studies are similar in nature and description to multiple case studies (Yin, 2003)

Case studies are in general related to misunderstandings about validity and reliability (Gibbert et al, 2008). Flyvbjerg (2006) described 5 of these misunderstandings of case studies. Since these misunderstandings are important to consider when implementing a case study they will be mentioned here.
The first misunderstanding Flyvbjerg describes is that:

"General, theoretical (context-independent) knowledge is more valuable than concrete, practical (context-dependent) knowledge" (Flyvbjerg, 2006, p.221).

This theory is refuted by Flyvbjerg because he states that predictive theories cannot be found in social science, this makes context-dependent knowledge more valuable than it seems.
The second misunderstanding is that:

"One cannot generalize on the basis of an individual case; therefore, the case study cannot contribute to scientific development" (Flyvbjerg, 2006, p.221).

Flyvbjerg explains that this is not true since it will depend on the particular case and the choices that are made. In most cases knowledge arises that is based on multiple sources, however it can also arise from one single source. He says that generalisation as described is overestimated to be a source of new findings, and a case study to be the source of new findings underestimated.
The third misunderstanding is that:

"The case study is most useful for generating hypotheses; that is, in the first stage of a total research process, whereas other methods are more suitable for hypotheses testing and theory building" (Flyvbjerg, 2006, p.221).

Flyvbjerg says that a case study can among other things be used to generate and test hypotheses. Some cases may even reveal more information because they are about different elements in the situation and activate more actors. Case studies tend to go deeper on underlying problems.
The fourth misunderstanding is that:

"The case study contains a bias toward verification, that is, a tendency to confirm the researcher's preconceived notions" (Flyvbjerg, 2006, p.221).

Flyvbjerg refutes this as verification and fact falsification apply to all research strategies. Because researchers are aware of this misunderstanding it has been demonstrated that case studies show a greater bias towards falsification of prejudices than towards verification.
The fifth and last misunderstanding is that:

"It is often difficult to summarize and develop general propositions and theories on the basis of specific case studies" (Flyvbjerg, 2006, p.221).

Flyvbjerg indicates that it is difficult to summarize case studies but it is not always useful. This depends on the case that has been studied and not on the research method (Flyvbjerg, 2006).

3.3 Case selection

The case study of understanding scientific controversies during the Q-fever epidemic in the Netherlands initially started with only the case study of the Dutch situation. This type of case study was assessed to be closest to the category of an instrumental case study, no clear selection was made on the basis of these categories. After performing several interviews it was striking that international experts disagreed on some levels what appeared to be due to a different occurrence of Q-fever in their country. Experts for example recommended measures that were used in their own country which were not immediately applicable to the Dutch situation. Because of the flexibility of an interpretive approach this allowed for the idea to make a comparison of two case studies of two different countries. The comparison had to give insight into the Dutch case study that otherwise would have been missed. Australia was chosen since Q-fever appeared to be different in their situation. Besides that, literature was in English which enhanced the collection and analysis. This comparative case study came closest to the category of a multiple-case study type. The approach was not meant to compare some features or characteristics, but to identify where they were different, so it could provide insight into other less obvious phenomenon of the epidemic concerning scientific controversies.

3.4 Data collection

As Haverland and Yanow (2012) stated:

"Once a methodology is adopted, the choice of methods becomes merely a tactical matter" (Haverland and Yanow, 2012, p.1).

To fulfil the aim of the research and to answer the research question, the choices of methods and underlying ways of knowing consisted of a literature study to gain insight into the event itself and the process of decision-making during the outbreak of a disease. The literature study was performed to describe for both cases how the organisational structure is put together and how decision-making works in case of an outbreak of a zoonotic disease. The interaction process of the political and science side played a central role. To construct the literature study mainly the internet was used and the library of the Wageningen University to search for scientific articles, websites of involved organizations, scripts and newspapers.

Data from the field was collected in the Netherlands to gain insight on these topics in the Q-fever cases. People from different organisations who took part in the process of decision-making were asked to participate in an interview. These were parties from the science side and parties from the political side. Different parties were asked for interviews as it is not only important how the process of decision-making took place (one actor could be enough) but also what the individualistic experiences, definitions and opinions are to preserve diversity of the key-stakeholders. The parties that were approached for an interview were; the ministry of Public health, Welfare and Sport (VWS), the ministry of Economic affairs, Agriculture and Innovation (EL&I), the Centre for Infectious disease Control (CIb) from the National Institute for Public health and the Environment (RIVM), the Dutch Food and consumer Product safety Authority (NVWA), the Animal Health service (GD), the Municipal Health Service in the North Brabant province (GGD HvB (Hart voor Brabant/heart for Brabant), and the Central Veterinary Institute (CVI). The GD and ministry of VWS had opted to no participation. In total 6 interviews were carried out.
The interviews were semi-structured to allow flexibility while still covering the topic. An overview of the questions is presented in appendix 1. Not every question was meant for every interviewee and because of new insights along the process not all questions were asked to all interviewee's. The interviews were tape-recorded which facilitated the interview itself, the analysis afterwards, and prevented data from being lost (Noor, 2008). After the interviews the interviewee's received the transcribed interview and had the opportunity to comment on text. Also some interviewee's wanted to see and approve the quotes from their interview that were chosen to be included in the report.
4 already existing interviews from another study were also used (public transcribed hearings of both Director Generals (DG) of the ministry of VWS, the Director General of EL&I and the director of the CIb from the Dutch study of the 'Nationale ombudsman' (2012b)). The DG's represented here the policy side. An overview of the interviews and hearings is presented in appendix 2.

3.5 Analysis

After every interview the transcribed texts were completed before the analysis. To implement the results in the report, the data was translated from Dutch into English. The same was done for the quotes that are used throughout the report. The Dutch quote has been submitted in a footnote. All interviews were treated confidentially, so no names are present at quotes, only the organisation.
Chi (1997) describes verbal analysis as:

"A methodology for quantifying the subjective or qualitative coding of the contents of verbal utterances" (Chi, 1997, p.273).

Coding is used to describe important details of the issue discussed and organises the data in such way to identify underlying patterns (Brent and Slusarz, 2003). Dierckx de Casterlé et al (2011) presented and discussed a method called 'the Qualitative Analysis Guide of Leuven' (QUAGOL). This method consists of 9 stages and this was used to analyze the interviews for this thesis.
In the first stage the interviews were transcribed and read thoroughly. In addition a report was written about the interviewee's and contextual characteristics of the interview. While reading the interview a global understanding of the interview as a whole was necessary and I had to search for the important parts that the interviewee tells that is relevant for the research question. These key phrases were underlined and if necessary meanings of some words or passages, thoughts or reflections were noted in the margins next to the text. In stage 2 the essence of the interview was phrased in order to find out about the essential characteristics of the interviewee's story. The answer sometimes contained paraphrases, abstract renderings or comments but was always written in a narrative way. After this stage a brief abstract of the key storylines including a summary impression of the characteristics of the interview were presented. In stage 3 a conceptual interview scheme was made. This provided relevant concepts to get insight into the essence of the interview. It also helped to keep track of the data as a whole. The key messages were filtered and linked to concepts. All concepts were ordered in a scheme and clarified when necessary. Later the concepts were further refined during the analysis. A clear example of a conceptual interview scheme is presented in the report of Dierckx de Casterlé et al In this example a central question is being posed, and the essence of the interview and explanations about the particular essence are presented. Completing and refining the conceptual interview scheme was done in stage 4. The scheme was being verified with the interview. The interview had to be reread with the conceptual interview scheme in mind. The questions that had to be answered when reading it were:

"Does the content of the conceptual interview scheme actually reflect the most important concepts in answer to the research question? Are there any other important concepts the researcher overlooks? Can the concepts of the conceptual interview scheme be linked to the interview data?" (Dierckx de Casterlé et al, 2011, p.366).

Stage 5 also further refined the conceptual interview scheme, but by identifying common themes and concepts. All schemes and all interviews were compared to each other to find new themes or concepts. These new elements were checked for their presence in other interviews. Based on these new insights the conceptual interview schemes were completed. Now the common essence of the interviews emerged. All adjustments were reported in an additional document to provide evidence of why decisions were made. Passing through these stages led to a complete overview of all key concepts.
In stage 6 a list was made of all these common concepts in non-hierarchical order. The list was used as preliminary codes (Dierckx de Casterlé et al, 2011). When producing a list of theoretically relevant categories, categories were not too concrete or specific (Blank, 2004). In stage 7 the list was assessed for its quality. The interviews were read again. While reading it, the next questions were answered:

"Does this list help me to reconstruct the story-line? To which extent do the concepts help me to identify and classify the significant passages in the interviews?" (Dierckx de Casterlé et al, 2011, p.367).

Each concept was linked to a passage of the interview. Some concepts were missing in some interviews but all important passages were linked to a concept. The codes of concepts were sufficiently defined to capture the essence. In stage 8 every code was analyzed. The following questions were important:

"Does every citation fit with the concept? Is there one common message describing the essence of the concept or can we discern more than one message? Can we maintain the concept as such, or do we have to split it into several sub-concepts? Do the empirical

data suggest congregating various concepts into one?" (Dierckx de Casterlé et al, 2011, p.368).

The specific meaning of the concepts was understood and phrased in my own words. A clear description of the concepts, their meaning, dimensions and characteristics, grounded in the empirical data was given. So, it resulted into a list with delimited and defined concepts. Stage 9 integrated all concepts in a meaningful conceptual framework or story-line in order to answer the research question. The concepts were organized and structured in a meaningful way based on the conceptual interview schemes. The final stage, 10, provided a reconstruction of the interview, based on a conceptual, theoretical level. In order to answer the research question the essential findings were described based on the in-depth analysis of concepts (stage 8) and the conceptual framework (stage 9). The result consisted of the core findings and the interconnection between the concepts. Quotes were included. All interviews had to be reread again for a final evaluation. The result had to be accurate and comprehensive. The questions asked were:

"Does the theory fit with all interviews? Are there missing concepts and if there are, are they essential? Are there negative cases (disconfirm earlier findings) and if there are, can the researcher explain these differences or discrepancies?" (Dierckx de Casterlé et al, 2011, p.368).

Dierckx de Casterlé et al describes this method as strong because of its underlying principles that have been supported by many authors. These principles are a case-oriented approach, a forward-backward dynamic by constant comparative method, combination of analytical approaches, and use of data generated sensitizing concepts as coding framework. Because the QUAGOL guide facilitates the process of analysis of qualitative interview data, it was used in this thesis (Dierckx de Casterlé et al, 2011).

3.6 Operationalization

After elaboration of the data, the theoretical framework was operationalized by a method developed by Bacchi (2009). This approach (*"What is the problem represented to be"*) is designed for policy analysis. She describes that policy does not address or react to problems but they constitute (or give shape to) problems. For the reason that a problem representation already carries implications how is thought about the issue and how people that are involved are treated, it matters how the problem is represented. By five interrelated questions it becomes clear how the problem of scientific controversy in the Q-fever outbreak is represented in both the Dutch and the Australian policy and how it evolves. These questions are crucial in understanding boundary work, the escalation and de-escalation of conflicts and the strategies used.
The five questions applied to this situation are:

1. What's the problem of Q-fever represented to be in the Netherlands and in Australia?
2. What presuppositions or assumptions underlie this representation of the problem?
3. How has this problem representation come about?
4. What is left unproblematic in this problem representation? Where are the silences? Can this problem representation be thought about differently?
5. What effects are produced by this problem representation?

This shows that in the problem there is already a certain understanding of what needs to change. By doing this the questions suggest that problems are not exogenous (existing outside), but are endogenous (created within) the policy-making process and process of creating knowledge. Because every question should address certain elements and consist of underlying thoughts the questions are explained in more detail. As mentioned every issue contains implicit problem representations. That is why in question 1 the implied problem representations in the specific issues are identified. As the problem contains

background knowledge that is taken for granted, question 2 refers to assumptions that are made in problems. But this does not include assumptions from experts themselves. By this question the conceptual premises that underpin specific representations can be identified. Question 3 contains two interconnected objectives. The first is to reflect on specific developments and decisions that influence how the representation of the problem is formed. The second is to recognise that representations are formed over time so they could also have developed very differently from how they are now. It is important to identify who's interests are being served in both countries by this representation. Question 3 actually searches for conditions that allow a particular representation of a problem to constitute and to assume dominance.
Subsequently in question 4 the critical potential is being explored. Here limits are considered in the underlying problem representations. It includes what is not problematized. So it has the purpose to bring issues and perspectives that are silenced into discussion. It needs to be identified who's interests are not being served.
Question 5 addresses to the fact that representations can create difficulties for members of some social group and these do not form a standard and predictable pattern. Therefore the question identifies the effects that influence specific representations of problems. This gives the opportunity to critically asses the result. The effects are discursive effects (from the limits imposed on what can be thought and said), subjectification effects (the ways in which subjects give shape to discourse), and lived effects (about life and death). Representations within policies often divides groups by putting them in opposition to each other. This is called dividing practices. Because representations also contain implications for who is responsible for the problem it is made clear by this analysis so people can consider whether or not they believe this is correct and what the impact of the effect has. Since the representation also directly affect peoples lives the objective is to identify which elements have deleterious effects on which people, and may be rethought. Bacchi made 5 sub-questions that should be considered in question 5:

"What is likely to change with this representation of the problem, what is likely to stay the same, who is likely to benefit from this representation of the problem, who is likely to be harmed by this representation of the problem, how does the attribution of responsibility for the problem affect those so targeted and the perceptions of the rest of the community about who is to blame?" (Bacchi, 2009, p.18).

Bacchi also indicated shortly what should be addressed to find answers for these questions. To answer question 1, it should be examined what experts propose of the implied evolvement of scientific controversy. Because the second question identifies underlying conceptual logics and political rationalities it involves a form of archaeology. To answer this question one must think beyond national and/or cultural boundaries to identify the key concepts, binaries and categories. The third question is answered by focusing on the practices and processes that led to the dominance of the problem representation. In the fourth question cross-cultural comparisons, comparisons of problem representations over time and discourse analysis can be useful in answering this question. In question 5 the three kinds of effects must be considered that are mentioned above (Bacchi, 2009).

3.7 Validity

The validity of the study was assessed by evaluating 5 criteria for reliability that are described by Guba and Lincoln (1985) in Tobin and Begley (2004). The criteria are: credibility (possible difference between the respondents' views and the researcher's presentation of them), transferability (generalizability of inquiry), dependability (process of auditing; it should be traceable and documented for others), confirmability (conclusions have to be interpretations of the data and not made up), and authenticity (different realities) (Tobin and Begley, 2004). This evaluation is described in chapter 8 discussion.

4. Case study the Netherlands

In the Netherlands Q-fever reached epidemic proportions in 2007 and remained a problem in the subsequent years. Human cases were related to the inhalation of bacteria – that can be transported across long distances by dust – originating from goat or sheep farms. Although, this link was not yet proven in the beginning. Mainly because a lot was unknown in the beginning about Q-fever, the Netherlands was struggling to fight the disease. An extended description of Q-fever facts is presented in appendix 3. During and after the outbreak there was much commotion about the approach (van Dijk et al, 2010). This chapter describes the Dutch management of diseases and the response to the Q-fever outbreak in chronological order.

4.1 The Dutch setting

In general there are 4 veterinary organisations involved in infectious disease control. These are: The Ministry of economic affairs, agriculture and innovation (EL&I), the animal health service (GD), the central veterinary institute (CVI) and the Dutch food and consumer product safety authority (NVWA). Humane organisations that are involved in infectious disease control are: The ministry of public health, welfare and sport (VWS), the national institute for public health and the environment (RIVM) and the Municipal Health Service (MHS/GGD). The role of these organisations is presented in appendix 4. As Q-fever in animals was a non-notifiable disease before the outbreak, it was the task of the farmer and the veterinarian with support of the GD to control the disease (van Dijk et al, 2010). Q-fever in humans has to be reported since 1975 (Roest et al, 2011) therefore an Outbreak Management Team (OMT) was convened. A detailed explanation of this process is presented in appendix 5. Besides OMT's there were also expert deliberations. These deliberations often contain the same people that are present in OMT's but OMT's are held in crisis situations for an acute problem and have a more urgent character. Expert deliberations are held for problems that are already longer present, when no immediate action has to be taken and are convened when problems occur. Experts in OMT's or expert deliberations form their opinion and therewith advice the BAO (Bestuurlijk AfstemmingsOverleg/administrative coordination meeting). The BAO consists of the managing board of the public health department of the ministry of VWS, representatives of GHOR-mayors, local public administration, and GGD-Netherlands. The BAO assesses advices on feasibility, scientific substantiation, support, ethics, legal level, communication, acceptation in society, desirability, and economical aspects of the individual farmer and the sector as a whole. These two structures; the expert or substantial part (OMT) and the managerial or political side (BAO) were consciously separated from each other in the past.

"When you represent more interests, and thus have the managerial side in mind; what will it cost and is it feasible? Then you are inhibited in the range of measures you want to see and treat" [1] *(Representative RIVM).*

This clearly indicates the purpose of the separation; experts in the OMT who are driven by content can entirely focus on substantive advice and not on other factors that will be assessed in BAO's. Although it is true that experts already take some factors lightly into consideration.

[1] "Op het moment dat je meer belangen vertegenwoordigd, dus ook die bestuurlijke kanten meteen in je achterhoofd hebt; wat gaat dat wel niet kosten, is het uitvoerbaar? Dan ben je geremd in het palet aan maatregelen wat je wilt zien en behandelen."

4.2 Q-fever as "nothing to be anxious about"

Q-fever occurs (excluding New-Zealand) mostly endemic, all over the world (van Dijk et al, 2010). An overview of outbreaks in different countries is presented in appendix 6. In several areas in Europe there were some Q-fever incidences before 2007. Here Q-fever was seen as a disease with a 'minimal general public health impact' (van Dijk et al, 2010). In the Netherlands the first three human cases were reported in 1956. In 1958 and again in 1967 two human cases were reported. From 1975 until the outbreak, every year between 0 and 32 human cases were reported (Roest et al, 2011). These people were cured after one to two weeks. In 2003 the GD came to the study of source research of abortion problems on goat farms after a human miscarriage occurred on a goat farm. On advice of the NVWA they also included *C. burnetii* in their study. In June 2005 the results indicated that *C. burnetii* was indeed present in aborting goats on three large goat farms in the Netherlands. A request submitted by CVI, RIVM and GD for an additional study on prevalence and diagnostics of Q-fever was rejected by the ministry of EL&I on January 2006. The infection of the three farms was discussed on 6 April 2006. After that the GD performed biannual monitoring of the bacteria and concluded in June 2006 that there were 6 other farms infected with *C. burnetii.* Three of the farms struggled with serious abortion problems. At that time, it was also reported that relatives of a farmer that recently visited a farm with abortion problems, were ill. This appeared to be Q-fever. The farmer and his/her family showed no symptoms (van Dijk et al, 2010). Eventually between 2005 and 2007 15 dairy goat farms and 1 dairy sheep farm with abortion problems were diagnosed with Q-fever (Roest et al, 2011). All cases were attributed to the regular incidence of 15 to 20 cases per year. Although the cases were accompanied by disturbing information such that the cases came from areas with a high incidence of goat farms and that the GGD in that region had a lot of patients with pulmonary symptoms at the same time, no measures or further consequences followed from these cases (van Dijk et al, 2010). An extended version of the outbreak is included in appendix 7.

4.3 A beginning problem

At the end of May 2007 the Bernhoven hospital (in the North of Brabant province) reported a cluster of pneumonia and a general practitioner (also in the North of Brabant province) reported an unusual cluster of patients with pulmonary symptoms to the GGD (van Dijk et al, 2010). When in July these 49 cases - reported from 15 May up to 17 July - showed to be Q-fever, this was seen, experienced and treated as a (potential) problem. But also as a temporary problem because literature described that it would be over after a year.

"It was certainly seen as a problem, but was not estimated such that it would become so large as it has become" [2] *(Representative Ministry of EL&I).*

Also, Q-fever was included on the list of emerging zoonoses but was not ranked very high. A lot of organisations saw that something unusual was going on and that it was not a case like others.

"It was not just one of the dozens of cases" [3] *(Huijts, Ministry of VWS, Hearing 16 April 2012).*

They were aware that it could become a problem in the future. The GGD consulted the RIVM, but because the RIVM did not saw it as a threat yet, they were told not to worry

[2] "Het werd dus zeker wel als probleem gezien, maar het werd niet dusdanig ingeschat dat het zo groot zou worden als dat het geworden is".

[3] "Het was niet gewoon een van de tientallen dossiers".

and handle it as it was a regional problem. The GGD also experienced no anxiety among the GD because they said along with some professors that it was always endemic and that the problem should not be created. Since nobody expected that it would grow into an epidemic, it was not yet seen as something top-priority. This also resulted into a lack of financial resources for research at first. Later a multidisciplinary research agenda for the short and medium term questions was compiled. All knowledge on Q-fever outbreaks from other countries were analysed for useful information. An extended description of the information from other countries is presented in appendix 8. According to Dutch scientists it was difficult to obtain foreign advice because it was not easy to explain the Dutch situation to foreign experts, and for them it was also complicated to properly advice on the Dutch situation.
It seemed that there was a lot of knowledge and experience abroad. For example, aborting and lambing in sheep or goats was found in many outbreaks the most plausible source of infection. Also a lot of literature described outbreaks that persisted for only one year and mostly occurred after contact infection. There were also many outbreaks described among animals that did not transferred to humans at all (van Dijk et al, 2010). Even though, these outbreaks abroad were described as being a lot different than what was happening in the Netherlands. They were incidental and point source and not seasonal, so also severe measures were never necessary.

"Disease control measures abroad were always focussed on point source, a single outbreak. That is of course easy to fight" [4] *(Representative NVWA).*

"They did not have the need for serious measures to prevent following outbreaks" [5] *(Representative CVI).*

Besides that, the fact that the Netherlands also has a large goat sector made it difficult to compare the event with other countries.

"We have a unique type of goat husbandry, intensive in scale, and in deep litter barns. Also the fact that it is all very close to habituation, was special. In many other countries there is much more space between farming activities and urbanization, so that made it very difficult to compare" [6] *(Representative RIVM).*

According to Dutch animal scientists literature therefore was almost never useful.

When the OMT was convened for the Q-fever case, veterinary knowledge had to be brought in because forming an OMT is a standard procedure from the humane side, so no veterinary knowledge was present. The intention was to create an OMT with experts on Q-fever, experts from the veterinary field, and representatives from the local GGD and the GD (van Dijk et al, 2010). However, there were at that time no experts in the Netherlands yet. Some of the veterinary knowledge was present at the GD and CVI and some of the humane knowledge at the RIVM and several hospitals, but it was all very fragmentary. It was known that Richardus wrote his PhD during the eighties on Q-fever, but he was not involved as an expert due to that he never continued research on Q-fever. Besides that, according to other experts his report could hardly be used because of old invalid diagnostics. International experts were not involved in OMT's but consulted by

[4] "Bestrijdingsmaatregelen zijn in het buitenland altijd gefocust geweest op 'point source', een enkele uitbraak. Dat is natuurlijk wel makkelijk bestrijden."

[5] "Ze hadden niet de noodzaak om zware maatregelen te nemen om volgende uitbraken te voorkomen."

[6] "Wij te maken hadden met een vrij unieke vorm van geitenhouderij, intensief qua schaalgrootte en in potstallen. Ook het feit dat het allemaal heel dicht bij de bewoning was, dat was bijzonder. In heel veel andere landen is veel meer ruimte tussen dierhouderijen en verstedelijking, dus dat maakte dat het gewoon heel moeilijk te vergelijken was."

international consultations in July 2008 and in 2010. A political strategy that was learned from previous outbreaks was to keep knowledge concentrated on one place so experts would not contradict each other in the media.

"Before that time we had learned from the birth flu that a lot of experts contradict each other on radio and television, and that we should keep the expertise together" [7] *(de Goeij, Ministry of VWS, Hearing 16 April 2012).*

On 23 July 2007 an OMT was held where an advice was formed including mapping human cases, providing proprietary data of infected farms and sending a letter with information to medical specialists in the region. In the BAO it was decided that EL&I would provide data of the farms, the public would not be informed, and no decision could been taken about making Q-fever notifiable because this is based on the burden of animals and the burden of people will add a new element (van Dijk et al, 2010). The fact that the public would not be informed led to discussion because the GGD wanted to do this. Later in the hearings the ministry of VWS (de Goeij, former DG) concluded that it is not possible for the government to forbid the GGD to inform the public.

4.4 Starting research

It becomes known in the year 2008 by research that there were already more Q-fever cases in humans in 2005 and 2006 but this was never reported. Also, in 2008 more media attention was given to Q-fever. In March 2008 the results of the epidemiological study about the Q-fever outbreak in Herpen (North Brabant) show that the bacteria spreads through the air (a milk goat farm is present at the east-side of Herpen that suffered from abortion problems caused by Q-fever) (van Dijk et al, 2010). However, following studies did not immediately focussed on goat farms, they investigated divergent potential sources that were indicated in literature. A test to prove bacteria in abortion material that was developed by the GD, led to the conclusion that goat farms were seen as the likeliest source. On the 3rd of June the OMT formed an advice that making Q-fever notifiable was priority (van Dijk et al, 2010). This was not done yet because no measures or risk factors were available, but from the humane side (humane experts, ministry of VWS) there was a lot of misunderstanding why this has not already happened. The humane side thought that the veterinary side acted reluctant. In the BAO it was reported that there were 149 human cases from 1 January up to 1 June 2008, while there were 196 cases in whole 2007 (van Dijk et al, 2010). On 12 June Q-fever was made notifiable in sheep and goats. Also was it not allowed to remove manure from the barn within 90 days after a Q-fever diagnosis. This measure was based on knowledge from Germany about manure. More foreign used measures on Q-fever are presented in appendix 9. When later research from the Netherlands provided more insight, the days were reduced to 30. Besides that, only inevitable visitors were allowed on the farm within 90 days after Q-fever diagnosis, this measure was based on experience not on scientific information that it would reduce Q-fever from spreading. Measures implemented at the beginning were based on ideas of the epidemic around that period. Since there were still doubts about the source, there was reluctance in the implementation of measures. On 22 July an international consultation was being held for questions that existed on blood donation and Q-fever in pregnancy (van Dijk et al, 2010). During these consultations exchange of knowledge happened with the ECDC and the European Food Safety Authority (EFSA). Unfortunately no uniform statement was formed on the questions.

[7] "Voor die tijd hebben we bij de vogelgriep geleerd dat er veel deskundigen over elkaar heen vallen op radio en televisie, en dat we die deskundigheid bij elkaar moeten houden."

"We had insufficient grip on it. Not that it was bad advice, but unfortunately knowledge provided not more" [8] *(de Goeij, Ministry of VWS, Hearing 16 April 2012).*

This indicates that not always advice towards the BAO was such that they could base measures on it. Besides this, the meeting also showed that experts from Australia looked differently at the Q-fever problem, they wondered about all the fuss because from their perspective there were relatively little patients yet. They also wanted to know why the Dutch government not started vaccinating humans instead of animals, though they did acknowledge that the Australian situation was different from the Dutch situation. The expert told that in the Netherlands they talk about how much sheep there are per square kilometre, while in Australia they talk about how much square kilometre there is per sheep.
In July the head of infection disease control of the GGD HvB – J. van de Sande – was agitated when he thought that public health was subordinate to agriculture and that it was a matter of compromising between both ministries. At the same time the DG of VWS (at that time de Goeij) corrected him multiple times on what the correct way was when new information was found as they saw this occurring in the media while they were not informed yet.

"I advised them to be wise and not tell the press first, but to share their information with the OMT or with Mr. Coutinho" [9] *(de Goeij, Ministry of VWS, Hearing 16 April 2012).*

In October there was discussion about the timeliness on the availability of information, more research was necessary. After the awareness came, finances were released. Voluntarily vaccination was started within a 45 km radius of Uden. During the vaccination campaign the efficacy of this precaution measure was studied. Also German experts on manure were consulted.

4.5 The need for more research results and measures

In 2009 a lot of research ended in results. There was never any question of contradicting results. In a BAO on 14 January 2009 it was decided that vaccination should be mandatory for all professional milk goat or milk sheep farms (with more than 50 animals) and farms with a public function. The former 45 km radius around Uden was expanded to the whole province of North Brabant. In March Australia published their findings on the vaccination program in humans, the vaccine against Q-fever showed to be effective. In the OMT of 11 May 357 new cases (from January 2009 up to 11 May 2009) were reported. Possibilities for a transport ban were inventoried, which is a measure based on experience with other diseases. Further research was done on a movement ban. Results of a manure research indicated on 11 June that there was still uncertainty on this topic. In a letter from the GGD that was sent on 15 July to EL&I, the GGD concluded that despite all measures there was no decrease, but an increase in cases. They asked for new measures (van Dijk et al, 2010). Coutinho, managing director from the CIb of the RIVM also sent a letter on 24 July to both ministries. He said that more severe measures were needed to make the number of patients go down. On 18 September parliamentary questions were asked by the PvdD (partij voor de dieren/ party for the animals) (van Dijk et al, 2010). In October 2009 the policy side (VWS & EL&I) made some scenario's and asked experts for advice how sure it was for every scenario that the number of Q-fever cases would decrease.

[8] "We hadden er onvoldoende houvast aan. Niet dat het een slecht advies was, maar helaas leverde de kennis niet meer op."

[9] "Ik raadde hen aan verstandig te zijn en niet eerst iets aan de pers te vertellen, maar hun informatie te delen met het OMT of met de heer Coutinho."

"This has led us, LNV and VWS together, at the beginning of October to ask the experts to assess a whole range of scenario's that we in accordance with policy invented, from business as usual to complete eradication"* [10] *(Huijts, Ministry of VWS, Hearing 16 April 2012).*

The RIVM was surprised about these scenario's since some were never brought up by experts as real opportunities. The experts advised eradication.
In the program Nova of 30 October Coutinho explained that he sent a letter to the ministries in July but this was not received enthusiastically. He said that this was because severe measures - what he asked for - will touch upon the benefit of farmers. The ministries declared that they have followed the advices of Coutinho. The Zembla broadcast of 6 December showed a lot of critique about how the economic interest was being preferred above public health. On 7 December the Lower House demanded clarity on measures (van Dijk et al, 2010). During this period combating Q-fever switched from risk control towards precaution. Especially around this time there were a lot of fierce debates. It was decided that pregnant goats (infected or not, because they have shedding-free periods) on infected farms would be eradicated (van Dijk et al, 2010). This measure was considerably debated. Also a breeding ban was implemented as precaution, this measure was also not based on scientific proof that it would prevent Q-fever from spreading, but if it was implemented earlier, eradication could have been prevented. On 21 December they started to eradicate goats on infected farms (van Dijk et al, 2010).

4.6 Sharpening the measures

On 1 January 2010 the implementation of a nationwide vaccination requirement started. On 6 January the minister of EL&I sent a letter to the Lower House as an update: there were up until that time in total 61 infected farms and 8,724 animals eradicated on 21 farms (van Dijk et al, 2010). Because research showed that within a 5 kilometre radius of an infected farm the chance of infection was higher, people in this radius were informed to pay attention on symptoms they might develop. This was also based on research that showed that when people know they live in a region with a positive farm they will see their general practitioner earlier and have faster an adequate treatment than people that do not have such information. Also general practitioners are more aware of the fact that it can be Q-fever, so the diagnosis will be made faster. A study at children's farms carried out by the NVWA led to discussion because it looked like the focus was shifted from livestock to children's farms but the RIVM thought that this could never be the problem. A day later the minister answered parliamentary questions of the PvdD; the Zembla broadcast was not the reason to start with other measures.
On 18 February it becomes known that the total number of human cases for 2009 is 2,368 (2,222 confirmed cases, 121 probable cases, and 25 with an unknown status). From 1 January 2010 up to 18 February there were 43 cases reported. 75 farms were infected and 43,200 animals were eradicated. On 1 March an emergency debate was being held; the government policy was highly criticized for not prioritizing public health. On 5 March the experts deliberation advised on the efficacy of vaccination; animals have a smaller chance of infection, it prevents abortion, and shedding of the bacteria during abortion is reduced (van Dijk et al, 2010). Up until July in the year 2010 there were 420 new patients with Q-fever (van den Brink, 2010a). On 26 November the RIVM reported that 15 (8 from 2008) people were deceased due to Q-fever. All patients also suffered from other diseases. In humans there were 4000 reported cases (NOS, 2010a). On 15 December general practitioners received a letter with information about the vaccination of risk groups. This measure was based on findings of the Australian vaccination

[10] "Dat heeft ertoe geleid dat wij, LNV en VWS samen, begin oktober de deskundigen hebben gevraagd om een hele reeks van scenario's die wijzelf beleidsmatig hadden bedacht, van business as usual tot complete ruiming, wat het geworden is, te beoordelen."

* Ministry of agruculture, nature and food quality. Former EL&I.

campaign that published their results in March 2009. During the year 2010 the number of human cases dramatically decreased with respect to previous years (RIVM, 2012a).

4.7 Evaluations of experts

The Q-fever outbreak of 2007 to 2010 in the Netherlands was the largest outbreak ever reported in the literature (Roest et al, 2011). From 2007 up until 31 September 2012 4173 *C. burnetii* infections in humans were reported. There were 25 reported cases of deaths (there is no systematic surveillance system for deaths from Q-fever, only acute cases are reported) (RIVM, 2012a). Commission van Dijk (van Dijk et al, 2010) was asked to evaluate the actions of the ministries during this large outbreak, as a lot of people had lost their confidence in the government (Nationale ombudsman, 2012a). One of the conclusions in their report of 2010 was that on the one hand the approach in communication was evidence-based, and on the other hand the government knows that transparency is of high interest to meet the information need of people. Many people were surprised about the fact that the US warned their citizens to stay away from farms in the Netherlands, while the Dutch government did not. However, the US acts more to the precaution principle because of the lawsuits and legal consequences. Their risk assessment is different, when something is avoidable and the government neglected this, this can lead to huge claims. Another conclusion from the van Dijk et al study was that the information that was available at the beginning or that became available during the epidemic, was not used as a basis or start for further action. Measures such as vaccination were already proven in other countries to be effective but were not considered as options at the beginning of the outbreak. Van Dijk et al also said that the option to extent the milk giving period without a dry period and lambing should have been raised sooner because this is a regularly used method on some farms. That goats and sheep were the source of human infections was already early in the outbreak a convincing fact for the RIVM and GGD. The commission also thinks that this fact was evident from previous outbreaks, while (in particular) the ministry of EL&I first wanted scientific proof for this. Scientific research initially had no priority in the outbreak, but as causality between human cases and goat farms was not identified, no adequate measures could be taken. Proving goats and sheep as the source of human cases was partly difficult due to the fact that the disease was also endemically present. One last conclusion was that the commission noticed that many measures were implemented in 2009, they think that this was because of an increased pressure due to a high increase in human cases, political pressure, increasing media attention and the Zembla broadcast. From that moment policy- and decision-making went from a proportionality principle and scientifically-oriented process of searching, into a precautionary principle and political driven process. However, it remained research focussed (van Dijk et al, 2010).

A lot of the above mentioned friction examples rely on the different opinion both ministries have on the value of scientific knowledge. This is why the working structure differs between them. The ministry of VWS works by the precaution principle, they take action when they have the least clue, to prevent other cases. A suspicion can become so evident that a true match is not necessary. Also when they take action this is usually about people or individuals and these individuals can decide if they will follow this measure. The ministry of EL&I on the other hand needs evidence before they can take action. This is because when they take a measure it is accompanied by an obligation. If the measure is not evidence-based, entrepreneurs (like farmers) can fight this by procedurals and gathering experts. A judge will decide that the measure is not valid, so EL&I will have to withdraw the measure. From other disease outbreaks it was learned that such affairs should be in order. This is why the ministry of EL&I wanted more research in the link towards goats. This conflict that arose between the ministries is also explained by the former DG of the ministry of VWS – de Goeij – as different rationalities from both ministries, VWS focussed on precaution and EL&I on evidence. This showed for example in the measure to make Q-fever notifiable, which took too long for VWS. Another dispute was that EL&I could not provide data of farmers that was present at the GD because they did not wanted to make this public. The OMT thought it was

unacceptable that the privacy of farmers was at stake. Besides the rationality difference, there is also a difference in structure between the ministries. VWS has their infection disease control decentralized controlled. This means that political/managerial staff works at the ministry and participate in BAO's and the experts who work at organisations like RIVM participate in OMT's. EL&I has this more centralized controlled. The managerial/political staff works at the ministry and participate in BAO's, but the experts work, besides at organisations like NVWA and CVI, also at the ministry. Due to the separation the experts at the ministry could not be consulted during the Q-fever outbreak, but they were represented in the BAO. Despite this difference the separation of science and policy was experienced as clear and well functioning by many experts. Also both ministries think there was good cooperation and no major disagreements, despite the conflicts.

"At the same time, I felt that we had good cooperation with VWS during the whole process from start to finish. We were open towards each other. We do had discussions, but we have been around each other just fine" [11] *(Burger, Ministry of EL&I, Hearing 16 April 2012).*

As this case study presented, the outbreak in the Netherlands started slowly and was not recognized as an outbreak in the beginning. It appeared to have seasonal peaks in the number of human cases and the outbreak showed characteristics of an environment infection. Another essential factor of the Dutch outbreak was that the dairy goat farm sector experienced a tremendous growth in density and extension the past years (Bremmer et al, 2012), the density is high and farms are close to residential areas. This changed the in-herd and between-herd epidemiology (Roest et al, 2011). Partly because these factors of the outbreak appeared to be different from foreign outbreaks, the situation was addressed very technocratic. There was great reliance on science, which was meant to be the solution and the source for decisions. However, as Pielke (2007) describes, not every situation can be solved with scientific knowledge. Situations that contain contextual factors as ethics, are failed to be resolved by information (Pielke, 2007). In the Q-fever case such factors were involved and when foreign experts showed to have other suggestions for solving the problem, this contributed to the occurrence of new problems which will be explained in chapter 5.

[11] "Tegelijkertijd heb ik in de samenwerking met VWS in het hele proces van begin tot eind het gevoel gehad dat wij een goede samenwerking hadden. Wij waren open naar elkaar. Wij hadden wel discussies, maar hebben steeds goed met elkaar opgetrokken."

5. Case study Australia

Q-fever occurred in Australia for the first time in the 1930s. Because of its long endemic existence and persistent upswing of human cases it was approached very differently than in the Netherlands. Underlying this is how the problem was seen here.

"In Australia Q-fever was more an occupational problem because in cattle around slaughtering it was a problem in the abattoirs, so that was a lot different than here." [12] *(Representative RIVM).*

This chapter describes the Australian general management of diseases, the occurrence of Q-fever in this country and their response to it, and the opinions of experts.

5.1 The Australian setting

The governmental department in Australia that is responsible for animal health, is the Department of Agriculture, Fisheries and Forestry (DAFF) (Australian Government; DAFF, 2012). The Department of Health and Ageing (DoHA) is responsible for public health, health protection and medical research (Australian Government; DoHA, 2012b). Together with the DAFF they coordinate the response to diseases, coordinate communication, are responsible for access to overseas trading markets, and for surveillance and intelligence on the disease. They also report to the World Organisation for Animal Health (OIE) (Post et al, 2004). For the protection of public health the DoHA has the division Office of Health Protection (OHP). From the veterinary side there is the Animal Health Committee (AHC) from the DAFF. The structure and process at the occurrence of infectious diseases is more elaborated in appendix 10.

The Communicable Diseases Network Australia (CDNA) works from the DoHA and provides a national public health perspective. The CDNA is involved in surveillance, prevention and control. They take decisions and inform the government and other organisations involved in communicable diseases. They also develop and coordinate surveillance programs (Australian Government; DoHA, 2012b). CDNA members, including members from other specialist organisations, meet on regular basis to discuss the approach of communicable diseases. In case of a zoonosis an animal health representative from DAFF will also be present at meetings. This person will provide inputs from the animal health perspective and report to animal health authorities (Stratton et al, 2006). The CDNA is a subcommittee of the Australian Health Protection Committee (AHPC). The AHPC advices the Australian Health Ministers' Advisory Council (AHMAC) on the preparedness for health emergencies (Australian Government; DoHA, 2012b).

5.2 A recognized occupational hazard

Q-fever is in Australia the most commonly reported zoonosis. It is also the country where Q-fever has been discovered for the first time when in the 1930s employees of a meat processor in Brisbane got a fever. They were at first diagnosed with 'Query' fever, because the cause was yet unknown (Australian Q Fever Register, 2012). Nowadays, Australia has one of the highest reported rates. The rates are 2 times higher than in France, 3 times higher than in the EU and 6 times higher than in the UK (Gidding et al, 2009). Q-fever is in Australia a notifiable disease and mostly seen in areas where small ruminants and cattle live near the population (Lowbridge et al, 2012). Q-fever is here endemic and outbreaks are usually of short duration (Department of Health, Victoria,

[12] "In Australië was Q-koorts meer een Arbo-probleem omdat dat bij runderen een probleem was en rondom slachtmomenten in het abattoir, dat was dus heel anders dan hier."

Australia, 2012). The disease is maintained in the wild by bush animals (Australian Q Fever Register, 2012). Cooper et al (2012) indicated the presence of *C. burnetii* in dingoes, cats, foxes, pigs, possums and bandicoots (Cooper et al, 2012). Already in 1958 bandicoots have been linked to an outbreak of Q-fever in Queensland, as no other species could be associated. *C. burnetii* has also been found in many tick species, especially ticks from kangaroos and bandicoots (Graves and Stenos, 2009). Because these feral animals come near urban areas and there is urban development in bushland, they may provide transmission to domestic animals and humans (Cooper et al, 2012).

In Australia Q-fever is originally known as an occupational hazard, because it occurs mostly in abattoir workers that recently handled contaminated feral goats or sheep from endemic areas (Department of Health, Victoria, Australia, 2012; Chong et al, 2002; Massey and Taylor, 2004; Gilroy et al, 2001). Also tannery and knackery workers, shearers, meat inspectors, dairy workers, animal-farm workers, animal transporters, wool sorters and veterinary personnel usually have a higher risk of contracting an infection (Department of Health, Victoria, Australia, 2012). These people get regularly into contact with placentas or milk of chronically infected livestock (Bennet et al, 2011). Australia introduced in 1989 a humane vaccination as a prevention strategy. Vaccination is applied in high risk occupational groups and causes mostly lifelong immunity (Department of Health, Victoria, Australia, 2012). In 2000 the National Q-fever Management Program was launched by the Australian Government (Lowbridge et al, 2012) and consisted of two phases. The first one focussed on abattoir workers and sheep shearers. The second phase expanded to sheep, dairy and beef cattle farmers, their employees and family members. People that live on the country side can choose to get vaccinated (Gidding et al, 2009). Because prior exposure to Q-fever or the vaccine can cause severe local reactions, pre-vaccination screening is needed by checking for a clinical history, vaccination, antibody testing and an intradermal skin test (Department of Health, Victoria, Australia, 2012). The program showed to be successful in having a significant impact on the incidence of Q-fever (Gidding et al, 2009). The decline in males between 20 and 59 years of age have been most obvious (NNDSS Annual Report Writing Group, 2010).

5.3 Recent change

From its discovery up to the vaccination program the number of human cases varied strongly. During this period, but also already when the vaccination program was applied, several outbreaks occurred. These are described in appendix 11.

Since its discovery Q-fever has always been associated with Australian abattoirs. For example in Queensland and Victoria 40-45% of all cases were abattoir workers (Massey et al, 2009b). Although in south-west Queensland the majority of recent cases has been associated with an occupation of farming (Massey et al, 2009b). Also in New South Wales this was reported. Between 1991 and 2000 51.4% of the Q-fever infections was seen in abattoir and meat workers. Between 2001 and 2010 this was only 10%, while cases in agriculture-related occupations increased from 29% in 1991-2000 to 52% in 2001-2010. This may have to do with the greater uptake of the vaccine in abattoirs, but it must also be mentioned that almost half of the cases in 2001-2010 did not had an occupational status (Lowbridge et al, 2012). However, it seems that the epidemiology has shifted in these states. Cases associated to non-abattoir contact like contact with livestock, wildlife or feral animals are increasing (Massey et al, 2009b). This shift was also reported when in 2006 5 people got sick that lived in a 1 kilometre radius of an abattoir that slaughtered goats in the Riverland town of Waikerie (Australian Broadcasting Corporation, 2007; Pedler, 2007). In recent years there is an increased prevalence in humans that had no contact with cattle, sheep or goats (Cooper et al, 2012). These people could not be related to meat or livestock workers. Experts said that the infection could be a result of inhalation of contaminated dust from the abattoir, while as indicated, it is usually the case that there is an association with meat or livestock workers (Pedler, 2007). Human

infections are now more and more associated with aerosol spread of the bacteria (Graves and Stenos, 2009). It is also suggested that wildlife plays a role in these cases (Cooper et al, 2012). Despite this, over 50% of all cases can still be linked to meat processing (GIDEON, 2011).

5.4 Experts opinion

The occurrence of Q-fever in Australia and the response to it may explain why their experts looked so differently at the Q-fever problem in the Netherlands. On the international consultation that was held for questions that existed on blood donation and Q-fever in pregnancy (van Dijk et al, 2010), they were wondered about all the fuss, as from their perspective there were relatively so little patients yet. The Australian expert Dr. Steven Graves advised to vaccinate humans, like is done in Australia. He was against eradication of animals. Roel Coutinho, Director from the Dutch CIb responded at the consultation that the vaccine QVAX is used in Australia for people with a certain profession and not for people with an increased health risk. Besides that it is not registered in the VS and Europe. The Health Council thought at that time that the literature was not sufficient yet to advice on the matter (van den Brink, 2010b).

"There was a huge difference in the way an Australian expert looked at our problems. He viewed it as; what are you all doing? And what a lot of hassle for relatively few patients, it was early 2009. In his perception. For him our veterinary control was quite special, as they would choose for human vaccination, though they acknowledged that their situation was not similar to the Dutch situation " [13] *(Representative RIVM).*

At the international conference in February 2010 it showed that there was international consensus about the way the Netherlands handled the epidemic. Although there was some criticism on the eradication of goats because they thought this was a too severe measure.

"There was international consensus that we could not have done more than we already have done" [14] *(Representative Ministry of EL&I).*

It appeared that foreign experts also learned from the Dutch outbreak. After the international symposium in 2012 the Australian expert Dr. Steven Graves warned all regional doctors in Australia. He informed them on the fact that if someone has a fever or pneumonia, they might have Q-fever. Even if they did not have had contact with animals (Locke, 2012).

On the international meeting also another but more extreme event occurred. This escalation example is however not based on Australia but on a French expert, nevertheless it gives the opportunity to elaborate more on the escalation of scientific controversies. Just as in Australia a different problem representation on Q-fever exists in France, but as will be seen this was not the only factor involved in this escalation. In France Q-fever occurs also endemically and research is performed there primarily by professor Didier Raoult. Professor Raoult works at the reference laboratory in Marseille and is working on Q-fever since 1984. Together with 8 other employees he works in his laboratory where they have tested more than 200,000 samples. He was also personally

[13] "Er was een heel groot verschil in de manier hoe een Australische expert naar onze problemen keek. Hij had zoiets van; wat zijn jullie toch allemaal aan het doen? En wat een hoop gedoe voor nog relatief weinig patiënten, het was begin 2009. In zijn perceptie. Voor hem was onze dierziektebestrijding wel bijzonder, want zij kozen voor het vaccineren van mensen, maar hij erkende wel dat hun situatie niet gelijk aan de Nederlandse situatie was."

[14] "Er was gewoon internationaal consensus over dat wij niet meer hadden kunnen doen dan wij gedaan hadden."

involved by consulting 800 individuals suffering from Q-fever. By authoring 182 of the in total 1183 published papers on Q-fever or *Coxiella burnetii* and creating a WHO and National reference centre on the disease, he indicated his extended experience and with that expertise he thinks he can help the scientific community to understand the disease better (Raoult, 2012). During the epidemic in the Netherlands there were 2 international consultations, he was invited to both. At the first one in the Netherlands he did not showed up. The next one was organised by the RIVM together with the ECDC in France, again in Paris he did not showed up. In the spring of 2012 he wrote an article in *'Journal of Infection'* (*Chronic Q-fever: Expert opinion versus literature analysis and consensus*). He described the Dutch outbreak from his perspective and formed his expert opinion on the case.

"*The extensive outbreak in the Netherlands generated a body of literature based solely on the consensus in the Netherlands. As a longstanding expert on Q fever, I offer my experience and recommendations to the E-CDC and the Dutch Q fever Consensus Group. My (biased) opinion is that experts deeply involved in the field continue to be useful in the management of outbreaks and can avoid decisions that produce an unfavorable progression in patients" (Raoult, 2012, p.102).*

In the article he stated that the Dutch way for the diagnosis of chronic Q-fever is not sound. Also the term 'chronic Q-fever' should not be used because it covers many different diseases with various sources. He thinks that people with acute Q-fever need to be followed-up by making cardiac films. Also a more severe antibiotic is necessary. He also thinks that local investigators and the ECDC did not had expertise on the disease. (Raoult, 2012). In June 2012 at the international symposium in Amsterdam he was invited as a guest speaker. The presentation was largely a repetition of his article. His criticism about handling the epidemic was not positive. He said that he was the expert and showed again that he had written a lot of papers about Q-fever. He was surprised that now research was done that he did already years ago (RIVM, 2012c). He also stated that the Netherlands thinks they have knowledge and understand the disease, but this is not true, according to him they are no experts. At the same time, Raoults research itself is debatable, according to Dutch experts. His studies would not contain representative groups. While in the Netherlands the research has overtaken this.

"We have more data, better substantiated, and carried out scientifically healthier research than he ever could do, because he did not have the high numbers of patients we had" [15] *(Representative, RIVM).*

This is why counter-responses came from other international experts, who stated that they have read his articles but could not do anything with it. Another response came from Roel Coutinho, who said that Raoult acted like he was ignored, while he was invited to get involved from day one, but he did not showed up. He also indicated that the outbreak was used to gain knowledge on the disease (RIVM, 2012c). Linda Kampschreur from the University Medical Centre Utrecht showed a table where the number of missed chronic Q-fever cases were presented when following the method of Raoult. Raoult responded on this:

"The future will tell us who is right" [16] *(Voormolen, 2012).*

He left right after his speech (Voormolen, 2012). The following day the Dutch newspaper NRC depicted him as a huge ego. He was mocked by writings as:

[15] "We hebben meer data, beter onderbouwd, en wetenschappelijk gezonder onderzoek gedaan dan hij ooit kon doen, ook omdat hij de hoge aantallen aan patiënten niet heeft die wij hadden."

[16] "De toekomst zal leren wie er gelijk heeft"

"The self-proclaimed king of Q-fever …" [17], "The southern French lion was given the opportunity to roar as one of the main speakers…" [18], and "The Dutch had seen the shot of hail from Marseille coming" [19] (Voormolen, 2012).

The different point of views of international experts was also partly due to the necessity of an extended view and good understanding of the Dutch situation, the political setting and the general setting at that moment. As mentioned, it was therefore difficult for them to advice on managing the epidemic in the Netherlands.

"The background of the problem made it hard for foreign experts to give sound advice on the approach of the problems we were facing… And you have to explain every time how the situation is in the Netherlands, that goats are kept indoors and that they are farms with 500 to 7000 animals, that sort of things" [20] (Representative CVI).

This case study showed that Q-fever in Australia is very different from the Netherlands. The occurrence is different, the outbreaks are different and therefore the approach is different. Because Q-fever also occurs in other countries, experts there will also have other views. It showed here that these ways of thinking can get quite out of hand and could not easily be solved.

[17] "De zelfbenoemde zonnekoning van de Q-koorts, …"

[18] "De Zuid-Franse leeuw mocht even flink brullen als een van de hoofdsprekers…"

[19] "De Nederlanders hadden het schot hagel uit Marseille zien aankomen"

[20] "Dus de achtergrond van de problematiek maakte het dat het toch ook voor buitenlandse experts lastig is om een gedegen advies te geven over de aanpak van de problemen waar wij voor stonden… En steeds moet gaan uitleggen hoe de situatie zit in Nederland. Dat die geiten binnen gehouden worden en het bedrijven zijn van 500 tot 7000 stuks, dat soort dingen."

6. Comparative analysis

In this chapter the five questions of problem representation that were formed – using Bacchi's (2009) method – earlier in the report, are answered. The analysis was carried out by usage of data from literature and from field research (interviews). By answering these questions the evolvement of scientific controversy should become clear. This method will show the differences between Q-fever in the Netherlands and Q-fever in Australia.

6.1 Problem representation

All questions of the problem representation are presented and explained in chapter 3.

What's the problem of Q-fever represented to be in the Netherlands and in Australia?

Q-fever was in the Netherlands never seen as a real problem until the outbreak. It was always endemic in livestock and only a small number of people got sick. It was not a top-priority issue and nobody expected it to be. This changed during the epidemic in 2007 until 2010. When people became ill of Q-fever it was still an unknown disease at that time, therefore information was collected from other countries. These foreign outbreaks showed that the Dutch epidemic stood out from the rest; there was talk of seasonal outbreaks, an environment infection and a large goat sector. This specific situation made it difficult to compare with outbreaks that occurred in other countries. Since Q-fever was not seen like this before, it was unknown how the disease would develop and how it should be treated. As more human cases occurred, measures were implemented that were not directly proven to reduce Q-fever from spreading and mostly also did not accomplish the desired result. Instead the number of human cases kept rising. This resulted into Q-fever from being represented as an manageable, regional and temporary problem in factory farming in the beginning, towards being represented predominantly as a dangerous unknown disease causing risks for public health. As indicated by its formal term 'epidemic' it immediately is loaded with associations of a sudden increase, a rapid spread and dangerousness.

This is differently in Australia because Q-fever has always been a problem here since its discovery. Because clusters of meat and abattoir workers were getting ill, the Australian Government decided to develop a vaccine. This vaccine has been available since 1989 for people that work with animals. After the national vaccination program launched in 2000 there was partly dealt with the problem as the occurrence of the infection in people in this sector, had reduced drastically. Because of this evolvement the problem is represented predominantly as an occupational hazard. This means that people that work intensively with livestock have a greater chance of getting infected than people that do not work with animals. However, lately there has been seen a shift in the infection group. The number of infections in abattoir and meat workers has decreased, while the infections of agriculture-related occupations increased. As the risk of getting Q-fever is higher when you work with livestock it still has the representation of an occupational risk.

6.2 Underlying presuppositions or assumptions

What presuppositions or assumptions underlie this representation of the problem?

In the Netherlands the problem of Q-fever being represented as a dangerous unknown disease which is a threat to human health contains underlying thoughts that

give meaning to the problem. By stating Q-fever as a national human health issue it is assumed that everyone can get infected and has serious consequences. No distinction is made here between different groups of people like elderly, children, pregnant women and people with an immune defensive disorder. While the consequences could be very different. By saying it is dangerous it is suggested that it spreads rapidly, people have a high risk of getting infected and that it can have a serious impact on peoples health, for example by a treatment that may not be sufficient. The fact that one is ignorant about the disease makes that it may not be prevented nor treated properly, and that a unique situation is going on.
There are different categories of actors that gave meaning to this problem representation. From the government the Netherlands had always two separate channels for humane and animal infectious diseases. From the veterinary side only a process will be triggered when a disease is notifiable, which was at first not the case in Q-fever. Because it was notifiable in humans an OMT and BAO were convened. However, without veterinary expertise this would not work as measures were highly involved in the veterinary field. In the veterinary field first evidence is necessary before measures could be taken. By lacking immediate aggressive governmental action and the absence of awareness of the disease to be a serious threat to human health, it resulted into the image of ignorance. By starting to alert people that lived near an infected farm they indicated that the problem was serious. The media was also highly involved in the problem representation since they played a big role in the communication between the people and organisations but also in how people think about the approach of Q-fever. They showed by stories of patients and doctors that the disease is a serious health problem. By showing the response of the government they contributed to the ignorance. Experts contributed to the knowledge of Q-fever by doing research. There were at the beginning some veterinary and human experts but no experts on Q-fever. There were only experts on Q-fever abroad. They were consulted during international consultations but were not involved in OMT's. The results showed that the disease could have serious consequences, especially for risk-groups.
The key concept identified in this problem representation is health, since this was considered as the most important factor by the media, experts and the government. At the same time, some people think that this did not prevailed above the economical interest in the governmental response and therefore contributed to the emergence of a serious public health issue. This is also the binary in this problem; economical interest versus social interest and therefore public health. This binary appeared along the way when no severe measures were taken while more and more people got ill. The public health side is in general considered more important than the economical interest. However, as said many people think that especially up until the end of 2009 the interest of the sector was priority. This has always been denied by the government and eventually led to two major studies after the outbreak; the van Dijk report (2010) and the study of the 'Nationale ombudsman' (2012a).

The representation of Q-fever to be an occupational hazard in Australia immediately suggests terrestrial differences. This indicates that the differences have to do with density or housing of cattle. As is known the distance in Australia of farms towards urbanization is large. Also density is low and cattle has access to large hectares of pasture. Also here no distinction is made between different groups of people that can work in this sector, while the disease can have different consequences for them. Also people that do not work with livestock probably do not have to worry of becoming infected.
The two most important categories that gave meaning to this problem representation are the government and experts. In Australia policy and expertise are more intertwined by joint decision-making structures. This occurs through DAFF membership in the CDNA. They made it possible that people could be vaccinated to prevent themselves. This made the risk lower of getting infected while working. Because the problem was concentrated and did not included an outbreak this

vaccination possibility was a preventive measure and not a control measure. Therefore the decisions made by the government were not taken under high pressure and were not extremely urgent. Because of the endemic occurrence since a long time Australia has a lot of experience on managing the disease. As Q-fever was always on the governmental agenda more research had been done and published, and more experience was present.
They key concept in this problem representation is occupational health. The chance of getting infected is higher when a certain profession is practiced. This indicates that it could be dangerous to choose a profession in this area. The binary here is also economic versus social interest. For certain reasons the government decided that the vaccine should become available to protect people, and even a national program was implemented. Some may think that the Australian government therefore chose with great conviction for the health of their people, despite economical consequences.

6.3 Evolvement

How has this problem representation come about?

The particular shape of this Dutch problem representation has been influenced in the process by different actors, one more than the other. The most important are: the government, experts, patients, farmers, the animals, and the media. The role of the government involves the prevention of the health of people and animals. But according to some people they responded not as action aimed as they should had responded. Also the van Dijk report says that they sometimes could have acted faster and when highly preventive measures were started from the beginning, maybe the problem would have not become the size it did. For example, the choice was made not to start with vaccination as was done in Australia. From the Netherlands they looked differently at the safety of the vaccination or the high economical impact that could be of influence. The problem of struggling in the beginning was also a result of no immediate uptake of the disease. This was partly due to the disease being non-notifiable in animals and also because there was no structure for zoonoses. Therefore the problem was approached from two sides separately. Also the fact that disease control staff that worked at the Ministry of EL&I could not be asked for advice because of the boundary between the political and knowledge side, was not beneficial for the prevention of the disease. Because the government is authorized to take decisions they had probably the greatest influence on the process of this problem representation. Experts that could be involved fulfilled their role in the process by doing research and advise on the problem. They used scientific research to make their statement. Because the problem was also framed as a lack of knowledge (unknown) there have been made so much appeal to experts and science. It was suggested that science would come up with solutions. This is a technocratic approach where much weight is given to scientific research and decisions will be made on the basis of these results. Therefore, experts were very important in this problem. Patients suffering from Q-fever had an interest of being heard and get a proper treatment. They created more awareness by using the media and therefore showed the urgency of the problem. They used their medical status and own experience to do so. Farmers or the sector also had an interest in the epidemic. They did not want to lose their farms, being financially affected and seen as the source of the problem. They used common organisations and each other to form a front and to defend their interests. Besides that, it was striking that in infected farms there was a geographically approach. This was characterised by presenting maps of infected farms and drawing circles around farms where measures were in force. The animals played a major role in the problem representation because different diseases that came from animals showed to be dangerous. Besides that they played also a role in the decision-making in the form of animal welfare. At the end of 2009 this was an important ethical issue in the process of the eradication of pregnant goats. Animal

welfare organisations represented this interest but were overruled by the government. The media also contributed in the process of this problem representation by publishing a lot about what was going on in areas of the epidemic. They drew attention on the problem by using perceptions of different groups. By underlining the fact that more diseases have already come from factory farming and showed to be dangerous (Mexican flu, Avian Influenza) were reason to believe or make people aware that Q-fever was also dangerous. All involved actors contributed by making the problem urgent, showed its dangerous sides and its magnitude. Some people think that the some actors had more influence in the process than they should have had, like the goat sector.

In Australia the government, experts, and the patients showed to have had an influence in the process of forming the particular shape of the problem representation. Besides these actors the agricultural situation in Australia might also have a major influence on the occurrence of Q-fever and thus on the problem representation. Because in Australia the number of human cases was quite high, there was need for a preventive measure. But as no major outbreak occurred, there was no high pressure on measures or research. Patients could have played a role in this awareness creation by using their medical status and experience to contribute to the decision by making a vaccine. By developing a vaccine and implementing the vaccination program for humans the government and experts used this to prevent more people from getting infected and the possibility of it to become a general public health issue. The shift from abattoir and meat workers towards people that work with livestock or to people that could not even be related to animals is not clear enough yet for Q-fever to be no occupational hazard anymore. Also here the awareness that other diseases from livestock showed to be dangerous, might have played a role.

6.4 Excluded from problematization

What is left unproblematic in this problem representation? Where are the silences? Can this problem representation be thought about differently?

In the Dutch problem representation it fails to be problematized that certain groups think that they were not heard enough. Doctors did not knew what to do with all patients, farmers disagreed with the eradication measure and animals did not have a vote in it at all. It also fails to be problematized that all measures have an impact. Especially ethical decisions. Because of this impact people might have lost their confidence in the government. In both countries – in the Netherlands after the outbreak and in Australia after the implementation of the vaccination program – the disease is still endemic. A certain number of human cases are considered normal and will not lead to a response. In the Netherlands the disease might emerge again and people are also again dependent on the government. Only people in risk groups are vaccinated so this might lead to uncertainty among people that are not vaccinated. It is also failed to be problematized that there are patients that will have symptoms for a very long time. Considering the problem of Q-fever in the Netherlands and the evolvement of the epidemic it can be questioned why there never occurred an outbreak in the Netherlands before.

In Australia it fails to be problematized that the disease is already for a long time known by the government and known by the people. The government is continuously working on the topic so people will not lose their confidence in the government. It is silenced as Q-fever being an occupational hazard, it might result into less supply of workers in this sector. Another possibility might be that Q-fever can lead to an outbreak in this country since not everyone is vaccinated. Also here people are dependent on the government, but they can get the vaccination. Besides that it is left unproblematic that some people do not want the vaccination because of its side-

effects or they are fundamentally against vaccination. What also fails to be problematized is that also other people might become infected. As is seen in the shift not everyone have to work with animals to become infected. People that come into contact with wildlife are also at risk.

6.5 Effects

What effects are produced by this problem representation?

In the Netherlands one of the discussions that has been going on at the outbreak of Q-fever was about factory farming. This was identified as a discursive effect. People fear that more diseases will occur from it when no action is being taken towards this sector. The fact that it was unknown at first led to a lot of research and to a lot of experience with the measures. There was high pressure on experts that needed to come with results and on the government that needed to take measures. It is likely that people might have less confidence in the government to prevent or control new zoonoses. This was identified as a subjectification effect. During the epidemic people could not do anything about getting infected or not. The effects were greatly on the patients whose lives became affected and farmers that were uncertain of their business existence. Also among citizens it created stress and fear. These were therefore identified as lived effects. By the uncertainty stated in the problem representation, people, patients and farmers are the actors that are harmed the most. The lack of knowledge was tried to be elucidated by research. This led to the focus on the identification of the disease itself and on factors that might influence the spread of the bacteria.
It is likely that the division of labour will remain the same although the structure will somehow change. One of the lessons from the ignorance that was learned is to integrate veterinary and humane experts. This is done by the establishment of the OMT-z (zoonoses) which is held monthly for zoonoses deliberation. Experts will be needed more to do research in yet unknown topics and pharmaceutical companies to develop and sell their products. It was for the government not beneficial to deal with an unknown dangerous disease. People might blame the government for not stopping the disease from going from a factory farming problem to a public health problem. This led to two major studies after the outbreak; the van Dijk report (2010) and the study of the 'Nationale ombudsman' (2012a). The overall impression of Q-fever in the Netherlands is that it was accompanied by a lot of stress and fear and that it was a big issue that kept the whole country occupied. The problem was refuted every time from being a small temporary problem to a public health issue and even had the effect that after the epidemic the problem continued in questions as what can be learned and who's to blame?

Defining Q-fever in Australia as an occupational problem might lead to that people will think they will not get infected when they do not work with animals. It implies that people that work in that sector will need to get a vaccination, while they might not want this because of side-effects or fundamental reasons. In effect the animals are after all the problem. These are identified as discursive effects. Working with animals has a risk and is therefore divided from other work. People might not want to take the risk of getting infected and the sector may lose people. This is identified as a subjectification effect. People that work in the sector and get infected could possibly be held responsible for their situation. This is identified as a lived effect. The approach for research developed differently from the Netherlands. In Australia scientific knowledge focussed largely on vaccination in humans. This is also an effect of subjectification. By tackling the problem humane, animals remained unaffected which will be encouraged by animal welfare organisations. It is likely that the sector will be seen as negative because dangerous diseases come from it. Groups against factory farming can reinforce their position and point of view using this situation.

Factory farming might get blamed for creating diseases that are a threat to public health. The sector as a whole will have to deal with a negative image. This is also an example of a discursive effect. Although the overall impression is that Q-fever in Australia is seen as something that is part of life and that they are coping with it in a more relaxing way. No hasty decisions had to be made which led to a structured and different approach.

7. Conclusion

In the Netherlands there is a clear boundary between the political side and the science side when it comes to a notifiable infectious disease. This is created by the OMT and the BAO and corresponds a neo-institutional approach. Here the policy and science side are separated by a powerful demarcation and sides have specific labour and interact in certain patterns. During the Q-fever outbreak the OMT contained experts on the veterinary and on the humane field. A consequence of this strict boundary was that veterinary experts that were present at the Ministry of EL&I could not participate in OMT's, nor be consulted for advice. The task of the OMT is to form their opinion and advice the BAO. The BAO consists of the managing board of the public health department of the ministry of VWS, representatives of GHOR-mayors, local public administration, and GGD-Netherlands. They will assess the advice from the OMT among other things on feasibility, scientific substantiation, support, legal level and economical aspects. The boundary is being maintained in this way on national level. Boundary work has also been studied in Australia. Here they have the CDNA which is involved in surveillance, prevention and control. They take decisions and inform the government and other organisations involved in communicable diseases. Policy and expertise are here more intertwined by joint decision-making structures. This occurs through DAFF membership in the CDNA, because in case of a zoonosis an animal health representative from DAFF will also be present at meetings. This person will provide inputs from the animal health perspective and report to animal health authorities. Besides the CDNA there are a lot of commissions involved, each with their own tasks. This shows that the boundary work in Australia had a stronger coordinating function than in the Netherlands.

The dividing function of boundary work was seen at the international level, here it arose between scientists on international meetings. This phenomenon occurred because Q-fever in the Netherlands was never a real problem and therefore an unknown disease until the outbreak, information was collected from other countries. These outbreaks showed that the Dutch epidemic stood out from the rest; there was talk of seasonal outbreaks, an environment infection and a large goat sector. This specific situation made it difficult to compare it with outbreaks that occurred in other countries. This resulted into Q-fever from being represented predominantly as a manageable endemic problem in factory farming, towards a dangerous unknown threat for public health. In Australia Q-fever has always been a problem since its discovery. First of all, the agricultural situation that can influence the occurrence of Q-fever, is a lot different. Secondly, the infection occurs most in people that work intensively with livestock. Because of this, the problem is here represented predominantly as an occupational hazard. It is seen as something that is part of life and that is handled quite relaxed. In other countries Q-fever will also be represented differently from the Netherlands, therefore foreign experts claimed at international meetings that their science was true and should be used while Dutch experts did the same on their side.
The different problem representations appeared to have led to international scientific controversies. Foreign experts did not fully understood the Dutch situation and international consultations were not held regularly. Therefore different point of views resulted into that foreign experts gave advise on something that was not a problem in the Dutch view or on something where other factors should have been kept in mind. Consequently such advise lost its value and eventually could not be used in the Dutch situation. The controversies could already be noticed before the meetings as they were presented in an article that was published years after the outbreak. The French professor Raoult published his paper in *'The Journal of Infection'* that contained his critical opinion on the response of the Dutch government and research implemented in the Netherlands. Since no interim strategy was helpful to elucidate the controversies the conflict escalated on an international meeting that followed in the same year. Here both parties claimed to be right about the problem and research and disagreed on handling the situation of the

epidemic. The escalation of the conflict between the Dutch party and the French professor Raoult was however not only a result of different problem representations but also of the fact that he had been working on the disease already for a long time and had suddenly been caught up by Dutch experts that were forced to deal with the disease and therefore did a lot of research. The French professor was identified as a scientific source, and the Dutch party contained experts and political staff. The critique about research was aimed at experts. Here rivalry that led to the escalation of the conflict can be characterized as the expulsion strategy. Both sides tried to legitimate their ideas by making it as scientifically as possible. The monopoly position remained on the science side instead of the policy side and boundary work was more a social control. The critique on the response and approach of the epidemic was aimed at the government. This corresponds to the strategy of protection of autonomy that led to the escalation of the conflict. The epistemic authority was used in ways that compromised the resources of other scientists. This strategy was used by the French professor to protect his professional autonomy.

The emotional, psychological and behaviour reactions that were involved with this conflict were assessed by many people. By judgement of field responses and media messages the conflict between Raoult and Dutch experts was assessed to be at approximately stage 5 of Glasl's (1997) conflict escalation model. The situation was already past stage 4 where the counterpart was seen as the problem, gaps in norms were exploited and attacks were made on core identities. During the conflict both parties tried to expose the counterpart and rehabilitated their dignity by showing scientific results and proof on their expertise. Herewith attacks were made on the public face of both parties, which led to working on restoring their prestige. These characteristics belong to stage 5. As Ravetz (2006) indicates, the result was a pseudo-debate where only power, privilege and profit are important. Assigning this stage to the situation provides insight into the understanding of the conflict and to be aware of it. The conflict can evolve even further as can be seen in the model. Stage 6 will be the next stage where panic-ruled actions and self-binding statements will be presented. This is the stage of extension of the conflict and where ultimatums are offered. The conflict can also de-escalate when other methods are used.

8. Discussion

This study shed light on why scientific controversies evolve as they do and how they can be handled better. To understand the evolvement of scientific controversies it is important to know that science has the task to provide facts and information and is often seen as a credible and reliable source. As described by Gieryn (1999), we are much more eager to believe and act on it if it is scientifically proven. Only uncertainties will arise when there is more than one scientific claim (Gieryn, 1999). Such power of scientific knowledge was seen in the Q-fever case when in the beginning little was known of the disease so international literature was consulted. This resulted into that some preventive measures were implemented, by the time the awareness came that the disease could get serious, research was started. It was tried to use scientific knowledge as main support so the approach was very technocratic. However, studies were carried out at the moment they were already needed. Since no contradicting results occurred in research this contributed to the idea of science to be credible and reliable. The importance of science during the epidemic also shows in the fact that the ministry of EL&I is more or less obliged to base decisions on scientific facts because of the possibility to get sued for non-scientifically based decisions.
In the Q-fever case there were also some strategies identified that were used to prevent conflict escalation. By keeping experts together and reminding each other of not sharing information first with the media but with the OMT, it was prevented that experts were divided into groups and that they thought that only their side produced facts that were true (Ravetz, 2006). Subsequently parties could not neutralize each other and the predomination of the more powerful political or economic interests was prevented (Pielke, 2007). Internationally this was not achieved, therefore different views occurred that led to conflict escalation.

As Pielke (2007) described, scientific controversies became a problem when the desire for the truth evolved faster than facts can clarify the issue. This happened in the Q-fever case when more people got sick and the disease had to be prevented from spreading. In the study of van Dijk et al (2010) it seemed that a lot of information was present abroad. However field research indicated that this could not be used for the Dutch situation. On national level two types of scientific controversy occurred that corresponded to the types that are described by Hines (2001); decisional controversies (taking action despite inadequate information) and ethical controversies (issue is part of morality, ethics, or preferences). That decisions in ethical issues will not remain only scientifically based, is explained by Pielke (2007). If such situations are handled scientifically, science will be incapable in resolving a conflict over values and even knowledge itself may be contested (Pielke, 2007). Since the Q-fever epidemic was partly framed as a lack of knowledge, the approach was technocratic. As the problem involved contextual factors like ethics a situation was created where scientific controversies could easily develop. This was seen in the ongoing pseudo-debate where Ravetz (2006) describes that only power, privilege and profit are important. Science could not contribute any longer and the credibility, legitimacy and epistemic authority of scientists no longer played a role. For that reason the integrity of scientists can be compromised (Ravetz, 2006).
Another controversy occurred on international level, here informational controversy (unknown is expected to be elucidated by further research) was seen (Hines, 2001). At the international meeting Raoult legitimized his interest of being the only expert by using his research. This is also what Pielke (2007) describes that in practice science is used by parties to legitimize their interests.

When we return to the second goal of the study, which was to provide guidance for how to handle controversies in policy and decision-making processes it is first important to know that conflict escalation does not always have to be avoided. Intense discussions can for example wake people up, make people identify what really matters and it can clear

the air. Escalation above some intensity will however not lead to valuable consequences but will be damaging and therefore should be avoided. Most important of all is to be aware of the situation going on. In conflicts boundary work can have besides the dividing function a coordinating function as conflict de-escalation. Pondy (1967) described three different models or strategies that can resolve a conflict. The first model is the bargaining model, this is used when there is a conflict among interest groups about scarce resources. The second is the bureaucratic model, which is used in superior-subordinate conflicts. The third model is the systems model, which refers to lateral conflict. This is used when there is a conflict among parties to a functional relationship. Besides these de-escalation models and when looking back on the Q-fever case, the prevention of conflict escalation in subsequent outbreaks logically also involves the creation of mutual understanding of the specific problem in the concerning country. It is thereby important to consider that in every country the rural organisation, way of housing and density differs. International meetings demonstrated to be important for such understanding by sharing data, specific problem situations and advice. When such meetings were organised more regularly during the Q-fever outbreak and thus foreign experts were more strongly involved, a better understanding of the disease and the influence of differences in countries would probably have been created. Boundary work would possibly not worked then as dividing but only coordinative. Then this could have led to a better cooperation and more useful advices on the management of the disease. Yet, it is first important to find out if the controversies presented in this study also occurred or could occur in other disease outbreaks. If so, a structural modification in the international approach towards infectious diseases may be considered. The first step might be to organise international meetings on a regular basis for the exchange of international knowledge. Also when contextual factors are included in such a problem it is necessary to involve people such as ethicists in the decision-making process. It is important to verify what is solved by science and what other approach can contribute to solve other contextual factors. This may be advantageous in any subsequent outbreak and in this way scientific controversies can perhaps be handled better.

After performing this study the choice of methodology can be assessed. To capture changes in situations, gaining a detailed understanding of social and organizational processes and to explore a problem itself in its context as was necessary in this study, the choice to use a case study was sound. The case study was first thought to be an instrumental and multiple-case type of study. It can now be assessed that the case study also shows characteristics of a descriptive, exploratory and intrinsic type. Because boundaries are not clear and there is overlap it is very difficult to categorize case studies. It was therefore not really useful to make a distinction in case study types at first. Despite that, the case study of the Q-fever epidemic provided an excellent example because of its complexity and showed to be a good example of how new emerging zoonoses can develop. Also the long period of the epidemic, the impact and the availability of many published reports were important for an objective and clear view of the problem process. This complex problem therefore showed to be a case where much was learned to prevent other emerging zoonoses to develop like this. Because there was so much documented the literature study could provide a lot of information. This also offered good preparation before field research was done. For the most optimal implementation of the research all people that were present at the BAO's and OMT's at the time of the epidemic should have been interviewed. This was however too much work and it also concerns people that are inaccessible for student interviews. This showed to be a limitation of the study. Despite this, the number of interviews and the people that were interviewed provided the requested amount of information. Questions could only have been more focussed to prevent elaboration to other topics. It should also be considered that the subject Q-fever is already extensively studied and therefore people that were involved participated already in a lot of researches. Therefore it was sometimes hard to find people that were willing to participate.

For the analysis of the interviews the QUAGOL analysis was used. This method was experienced as a clear and good method. It is however recommended to find a translator for data because it was sometimes difficult to cover the loading of the message in English. Choosing other words may present the message not as how it was intended.
To evaluate on the research as a whole Tobin and Begley (2004) described 5 criteria for reliability from Guba and Lincoln (1985). The first one is credibility, this represents the possible difference between the respondents' views and the researcher's representation of them (Tobin and Begley, 2004). By presenting quotes, different views, and giving the opportunity to the interviewee's to change the text, credibility is demonstrated. The second criteria is transferability which is the generalizability of case studies. As Flyvbjerg (2006) already explained, the generalizability of case studies depend on the particular case and the choices that are made. Knowledge can arise from one single source. The number of people that were interviewed for example, do not form a representative group but it is the form of analysis that makes sure that it can contribute to scientific development. These methods can be applied in other situations as well. Dependability is the third criteria. The possibility to audit the study is ensured by being open about the methodology and data, recording interview data, giving the opportunity to the interviewee's to change the text, displaying multiple views, presenting quotes to give the opportunity to readers themselves to determine, and documenting interview data relatively in their original form. The fourth criteria is confirmability. This refers to conclusions that have to be interpretations of the data and not made up. This is fulfilled by presenting different perspectives and interpretations, documenting all field data and by a structured approach. The last criteria authenticity, is achieved by showing different realities, using semi-structured interviews, multiple sources and a discussion on the topic (Tobin and Begley, 2004).

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Appendices

Appendix 1. Questionnaire interviews

Probleem algemeen: [21]

- Werd Q-koorts al als probleem gezien in 2007?
- Van Dijk beschreef dat er vanuit de literatuur werd gezegd dat de ziekte altijd endemisch voorkomt en altijd vanzelf weer overging. Werd er aan het begin door iedereen zo over gedacht of waren er toen al partijen die bang waren dat het weleens veel groter zou kunnen worden?
- Wanneer kwam voor u het punt dat u dacht, nu is Q-koorts echt een probleem voor Nederland?
- Werden de problemen met Q-koorts die er in het buitenland waren anders gezien dan die er in Nederland waren of was dit een vergelijkbaar probleem?

Ervaring/bestaande kennis:

- Aan het begin van de epidemie was nog niet alles bekend, werd hierdoor een bepaalde strategie aangehouden? En toen er meer informatie beschikbaar kwam, veranderde dit?
- Was er bruikbare wetenschappelijke informatie bij aanvang van de epidemie (2007)?
- Van Dijk zegt dat wetenschappelijk onderzoek aanvankelijk geen prioriteit kreeg, wanneer werd er echt met onderzoek gestart?
- In van Dijk staat dat er ook wat ervaringen vanuit het buitenland waren qua bestrijdingsmaatregelen. In hoeverre werden die meegenomen in het besluitvormingsproces of waren die niet bruikbaar?
- In hoeverre werden ervaringen van andere dierziekten uitbraken gebruikt bij deze uitbraak?

Tijdens de uitbraak:

- Hoe stonden verschillende partijen tegenover wetenschappelijke kennis? Vonden sommige partijen dat er meer informatie nodig was om maatregelen op te baseren of juist dat er van een best guess uitgegaan kon worden?
- Zijn er nog resultaten van een onderzoek geweest die tot veel discussie hebben geleid binnen het besluitvormingsproces?
- Welke rol heeft wetenschappelijke kennis (voor en tijdens de epidemie) uiteindelijk gespeeld in de maatregelen die werden getroffen?
- Hoe doorslaggevend werd het wetenschappelijke bewijs van geiten en schapen als bron, gezien en welke rol speelde dit in de maatregelen eind 2009?
- Is er wetenschappelijke informatie geweest die elkaar tegensprak?
- Zijn er maatregelen ingesteld die helemaal niet op wetenschappelijke informatie gebaseerd zijn?
- In het besluitvormingsproces speelde wetenschappelijke kennis een rol en bijvoorbeeld ook ethiek. Waren er nog andere belangrijke factoren waarmee rekening moest worden gehouden?

OMT:

- Hoe sterk was de scheiding tussen de deskundigen/advies-kant en de beslissings/bestuurlijk-politieke-kant?
- De deskundige en bestuurlijk-politieke rol is uit elkaar gehaald op basis van situaties in het verleden. Waarom is dit gedaan en heeft het tijdens deze epidemie goed gewerkt?
- Wat is het verschil tussen het deskundigenberaad en het OMT?
- Werden alle adviezen van het OMT opgevolgd?

[21] niet iedere vraag is gesteld aan iedere partij en is ook niet voor elke partij even goed te beantwoorden

- Waren er bij aanvang van de epidemie al (internationale) experts die bezig waren met onderzoek en die werden ingeroepen voor hulp?
- Werden internationale deskundigen bij het OMT of deskundigenberaad betrokken of alleen tijdens een internationale consultatie geraadpleegd?
- Er zat ook kennis bij het ministerie, maar hoe werd deze dan gebruikt, gezien de scheiding tussen de bestuurlijk politieke en deskundige kant?
- In hoeverre hebben andere partijen dan de VWS en EL&I in het BAO invloed op de beslissing?
- Zijn er na de uitbraak reacties vanuit het buitenland geweest die zeiden jullie hadden het heel anders moeten doen?

Appendix 2. Overview interviews and hearings

Organisation	Date
Ministry of EL&I	2 October 2012
GGD HvB	9 October 2012
RIVM (LCI & LZO)	30 October 2012 and 8 November 2012
NVWA	31 October 2012
CVI	1 November 2012

Organisation	Who	Function	Date
Ministry of VWS	ir. J.I.M. de Goeij	DG from June 2002 untill March 2009.	16 April 2012
Ministry of VWS	drs. P.H.A.M. Huijts	DG since March 2009.	16 April 2012
Ministry of EL&I	ir. A.M. Burger	DG since November 2007.	16 April 2012
RIVM	prof. dr. R.A. Coutinho	Managing director CIb.	16 April 2012

Appendix 3. Q-fever facts

Q-fever is a zoonotic disease caused by the bacteria *Coxiella burnetii.* Human cases were in the Netherlands diagnosed for the first time in 1956. Prior to 2005 approximately 20 human infections were seen annually (EFSA, 2010). A lot of mammals and even birds can get Q-fever. In the Netherlands it is most commonly seen and known in sheep, cattle and goats, which are the main reservoirs of the bacteria (Delsing et al, 2011). The bacteria is shed by infected animals in their body fluids like saliva, urine, faeces, milk, placenta and amniotic fluid (Porter et al, 2011). In goats and sheep *C. burnetii* causes abortions and stillbirths resulting in high concentrations of the bacteria, which are the main sources for infection (Delsing et al, 2011). Humans get infected in most cases by inhalation of the bacteria that can be transported across long distances by dust. *C. burnetii* is extremely infectious, inhalation of a single *C. burnetii* bacteria can lead to infection. To a lesser extent, people can get infected by consuming raw milk (products) or undercooked infected meat. Human to human transmission does not take place, however it has been described after contact with parturient women, and also vertical transmission has been reported. In this case a child can get infected by the mother through the placenta or colostrum (Porter et al, 2011).

When humans get infected they mostly do not develop symptoms or only symptoms that look like a mild flu infection (Roest et al, 2011). In other cases, after on average 1-3 weeks following infection, nonspecific symptoms like severe flu-like symptoms occur (Porter et al, 2011). The symptoms include a high persisting fever, severe headache, fatigue, soar muscles, sweating, loss of appetite, nausea, vomiting, diarrhoea, coughing and chest pain (RIVM, 2011). In some cases the lungs or liver become inflamed without the above-mentioned symptoms (Porter et al, 2011). In pregnant women an infection with *C. burnetii* can lead to abortion or premature delivery (Roest et al, 2011). The disease can also become chronic, which can happen in 1 to 3% of the cases. In chronic Q-fever the bacteria will remain active in the body. This is mostly seen in patients with a body-defence disorder or hart patients, and also pregnant women have a higher chance of developing chronic Q-fever (RIVM, 2011). 60-70% of chronic Q-fever patients develop endocarditis (Porter et al, 2011).

Appendix 4. Dutch Organisations involved in infectious diseases

Veterinary:

The Ministry of economic affairs, agriculture and innovation (EL&I)
The ministry of EL&I monitors animal health in the Netherlands permanently. They establish rules and are responsible for controlling the disease (van Dijk et al, 2010).

The animal health service (GD)
The GD is a private organisation that supplies services to the government, but also to farmers and the dairy- and meat industry (van Dijk et al, 2010). By monitoring, implementing voluntarily- and mandatory disease programs, doing research, develop knowledge about animal health, providing information, and support at outbreaks, they play a major role in animal health (GD, 2012).

The Dutch food and consumer product safety authority (NVWA)
The NVWA monitors the health of animals and plants, animal welfare and the safety of food and consumer products. The NVWA consists of 5 divisions. The division veterinary and import plays a role in monitoring and controlling zoonotic risks (NVWA, 2012b).

The central veterinary institute (CVI)
The CVI is part of the Wageningen University and Research Centre (WUR). The CVI does research in the field of animal health. They also focus on zoonoses. They are responsible as a reference laboratory for diagnostics on animal diseases. Commissioned by the government they carry out research projects (CVI, 2012).

The agri- and horticulture organisation the Netherlands (LTO)
LTO is not directly involved in the control of infectious diseases, but they played a role in the Q-fever outbreak. LTO represents agricultural entrepreneurs and they stand up for the economical and social position of farmers (LTO Nederland, 2012).

Humane:

The ministry of public health, welfare and sport (VWS)
The ministry of VWS is responsible for the prevention and control of infection diseases. This means; the implementation of measures, crisis management, the introduction of a vaccination and nationwide education (van Dijk et al, 2010).

The national institute for public health and the environment (RIVM)
The RIVM is the organisation of knowledge for the ministry of VWS. The centre for infectious disease control (CIb) is part of the RIVM. The CIb coordinates the control of national or rare outbreaks of infectious diseases, advices and conducts scientific research. This is the centre of knowledge for among others the MHS's. The CIb consists of several departments, the national coordination structure for infectious disease control (LCI) is one of them. They are involved with the communication towards the field. The laboratory of zoonoses and environment biology (LZO) is also one of the departments, they investigate sources and the transmission, identify risk factors and assess these risks (RIVM, 2012b).

The Municipal Health Service (MHS/GGD)
The GGD are on regional level involved in the control of infectious diseases. They carry out source- and contact investigations, advice on preventive measures and inform the public (GGD, 2012).

Appendix 5. Structure in the approach of infectious diseases in the Netherlands

Q-fever in animals was a non-notifiable disease before the outbreak occurred in the Netherlands. At non-notifiable diseases it is the task of the farmer and the veterinarian with support of the GD to control the disease (van Dijk et al, 2010). When the disease is listed as a notifiable disease, the farmer, veterinarian or laboratory must inform the NVWA by calling the national hotline for animal diseases (Rijksoverheid, 2012). Some general data of the farm will be recorded and passed on to the Veterinary Incidents and Crisis centre (VIC) of the NVWA. This centre evaluates the incoming messages. In case of a serious disease a team of specialists will be sent to the farm. In case of a less serious disease, a NVWA-veterinarian will be sent (NVWA, 2012a). The NVWA is responsible for the implementation of the control while the ministry of EL&I is responsible for the control of animal diseases itself. For some diseases there are national scripts available. When such a disease occurs, European control guidelines from the script will be followed. Besides that the secretary of EL&I can take additional measures, advised by the Chief Veterinary Officer (CVO) and a group of experts (Rijksoverheid, 2012).

Q-fever in humans has to be reported since 1975 (Roest et al, 2011). Patients that suffer from Q-fever will mostly first see their general practitioner for pulmonary symptoms. A Q-fever diagnosis must be reported to the GGD of the corresponding municipality. The GGD will inform the mayor and the RIVM. The GGD also reports the message through a system called Osiris that keeps record of all mandatory notification diseases. When a disease stays regional, the GGD with support of the centre for infectious disease control (CIb) will fight the disease. When the disease gets national, the CIb takes over this task and an Outbreak Management Team (OMT) will be convened. For the Q-fever case veterinary knowledge had to be brought in because forming an OMT is a standard procedure from the humane side, so no veterinary knowledge was present. The intention was to create an OMT with experts on Q-fever, experts from the veterinary field, and representatives from the local GGD and the GD (van Dijk et al, 2010). However, there were at that time no experts in the Netherlands yet. Some of the veterinary knowledge was present at the GD and CVI and some of the humane knowledge at the RIVM and several hospitals, but it was all very fragmentary. It was known that Richardus wrote his PhD during the eighties on Q-fever, but he was not involved as an expert due to that he never continued research on Q-fever. Also, according to other experts his report could hardly be used because of old invalid diagnostics. The structure of veterinary and humane experts in the OMT in the case of zoonoses is now continued after the outbreak in the form of a monthly OMT-z (zoonoses). International experts were not involved in OMT's but consulted by international consultations in July 2008 and in 2010. Here advice comes from the Dutch Council of Health, the European Centre for Disease Prevention and Control (ECDC), the World Health Organisation (WHO), and the American Centre for Disease Prevention and Control (CDC).

Experts in the OMT form their opinion and therewith they advice the BAO (Bestuurlijk AfstemmingsOverleg/administrative coordination meeting) Sometimes advices go directly from the OMT towards the ministers but usually the BAO assesses advices on feasibility, scientific substantiation, support, ethics, legal level, communication, acceptation in society, desirability, and economical aspects of the individual farmer and the sector as a whole. The final decision is made by the director general of VWS on behalf of the minister. The expert or substantial part (OMT) was consciously separated in the past from the managerial or political side (BAO). During the Q-fever outbreak this boundary was clear and worked well, despite structures in infection disease control are different in both ministries. VWS has their infection disease control decentralized controlled. This means that political/managerial staff works at the ministry and participate in BAO's and the experts who work at organisations like RIVM participate in OMT's. EL&I has this more centralized controlled. The managerial/political staff works at the ministry and participate in BAO's, but the experts work, besides organisations like NVWA and CVI, also at the ministry. Because of the separation the experts at the ministry could not be consulted,

but were represented in the BAO. Due to this separation experts in the OMT who are driven by content can entirely focus on substantive advice and not on other factors that will be assessed in BAO's. Although experts already take some factors lightly into consideration.

A bridge between the OMT and BAO was created by the chairman of the OMT – the director of the CIb; Roel Coutinho – who was present at every BAO meeting. Besides OMT's there were also expert deliberations. These deliberations often contain the same people that are present in OMT's but OMT's are held in crisis situations for an acute problem and have a more urgent character. Expert deliberations are held for problems that are already longer present when no immediate action has to be taken and are convened when problems occur.

The BAO is usually composed of the managing director of the CIb, the managing board of the public health department of the ministry of VWS, representatives of GHOR-mayors (Geneeskundige Hulpverlening bij Ongevallen en Rampen/medical assistance in accidents and disasters), local public administration by the mayor and the association of Dutch municipalities, and GGD-the Netherlands, but the composition may differ. The DG of the ministry of public health, welfare and sports is chairman. The DG of the ministry of agriculture, nature and innovation can be invited by the chairman to participate. It is tried to create synergy between the humane and veterinary side but no consensus has to be reached per se, although this is useful because the organisations in the BAO need each other at the implementation of measures. The decision is made by the entire group, and these will be reported to the management of involved organisations like the GGD, VWS and EL&I (van Dijk et al, 2010).

During the Q-fever outbreak no real choice was made at the beginning between acting on the precaution principle and acting based on evidence but public health always prevailed. Almost all advices created by the OMT were followed at the BAO. Only an advice about public communication that was formed at the beginning of 2007 and also the advice of making the disease notifiable were not followed by the BAO. After implementation of the advices that were followed, they were assessed in the following OMT's.

Appendix 6. Foreign outbreaks of Q-fever

Before the outbreak in the Netherlands, in 14 of the 27 EU members infections in animals must be reported, but there are no EU regulations to prevent Q-fever from spreading. Infections in animals were not being monitored, but Q-fever occurs (excluding New-Zealand) mostly endemic, all over the world (van Dijk et al, 2010). In 1956 there were 1358 clinically suspected human cases reported in Uruguay. 814 cases were serologically confirmed (Delsing et al, 2011). In Australia one of the highest Q-fever rates are reported. They started a national program in 2001 by vaccinating humans in risk groups. These are people that have a job related higher risk of getting infected. People that live on the country side can choose to get vaccinated. The program showed to be successful by having a significant impact on the incidence of Q-fever (Gidding et al, 2009). In different areas in Europe there were some Q-fever incidences before 2007 and not all were directly job related. Q-fever was seen in the EU as a disease with 'minimal general public health impact' (van Dijk et al, 2010). A high seroprevalence in animals and a low number of human cases is normal in most European countries (Roest et al, 2011). For example in Germany there were a number of Q-fever outbreaks in humans reported after the Second World War. They traced most of these outbreaks back to sheep (van Dijk et al, 2010). A distinctive incident happened in 2003 on a farmers market where 299 visitors became infected because of an lambing ewe (Delsing et al, 2011). The most clear relation of infection between animals and humans was set in 2005 in Jena. 331 humans got Q-fever from an infected sheep flock that bordered a residential area. Research showed that the risk of getting infected increased the closer the residence was to the meadow (Gilsdorf et al, 2008). Nowadays each year about 130 cases in animals are reported by systematically monitoring antibodies (van Dijk et al, 2010). Switzerland reported an outbreak already in 1983. 415 inhabitants from villages became infected after exposure to aerosols from a nearby flock of 900 sheep (Delsing et al, 2011). Also Bulgaria suffered from outbreaks. During the last ten years there were 12 major outbreaks reported. The most probable cause of the outbreaks was traced back to goats, since the recent extension of the sector in Bulgaria. The disease has been made notifiable in animals. In France it is known that the disease is endemic in animals, however human and animal cases are not being monitored. Q-fever does not need to be reported (van Dijk et al, 2010). In the Netherlands the first three human cases were reported in 1956. In 1958 and again in 1967 two human cases were reported. With the exception of one patient from 1956, all patients could be linked to livestock or livestock products. A study in 1983 concluded that infection in 67% of 33 cases that were reported between 1979 and 1983 could be related to animals or animal products. In the same year another study showed a higher risk of infection with Q-fever for people that work with animals. From 1975 until the outbreak, every year between 0 and 32 human cases were reported. (Roest et al, 2011).

When the outbreak in the Netherlands started in 2007, there have been three Q-fever outbreaks documented in the same year in the United Kingdom, Slovenia and Australia (Karagiannis et al, 2007). In the United Kingdom 5 cases occurred in a town of Gloucestershire. No occupational risk factors or common exposures have been identified (Health Protection Agency, 2007). In Slovenia a group of 33 veterinary students and two teachers were diagnosed with Q-fever after a training on a sheep farm (Grilc et al, 2007). In Australia 5 people got sick that lived in a 1 kilometre radius abattoir that slaughtered goats in the Riverland town of Waikerie (Australian Broadcasting Corporation, 2007; Pedler, 2007).

Appendix 7. Q-fever timeline of the epidemic in the Netherlands

A beginning problem

At the end of May 2007 the Bernhoven hospital (in the North of Brabant province) reported a cluster of pneumonia and a general practitioner (also in the North of Brabant province) reported an unusual cluster of patients with pulmonary symptoms to the GGD (van Dijk et al, 2010). When in July these 49 cases - reported from 15 May up to 17 July - showed to be Q-fever, this was seen, experienced and treated as a (potential) problem. But also as a temporary problem because literature described that it would be over after a year. Also, Q-fever was included on the list of emerging zoonoses but was not ranked very high. A lot of organisations saw that something unusual was going on and that it was not a case like others. They were aware that it could become a problem in the future. The GGD consulted the RIVM, but because the RIVM did not saw it as a threat yet, they were told not to worry and handle it because it was a regional problem. The GGD experienced also no anxiety among the GD because they said along with some professors that it was always endemic and that the problem should not be created. An OMT was held on 23 July where an advice was formed about mapping human cases, noting complications, providing proprietary data of infected farms and sending a letter with information to medical specialists in the region. In the BAO it was decided that EL&I would provide data of the farms, the public would not be informed, and no decision could been taken about making Q-fever notifiable because this is based on the burden of animals and the burden of people will add a new element (van Dijk et al, 2010). The fact that the public would not be informed led to discussion because the GGD wanted to do this. Later in the hearings the ministry of VWS (de Goeij, former DG) says that it is not possible for the government to forbid the GGD to inform the public. The increase in incidence was not yet seen as something top-priority because nobody expected that it would grow into an epidemic. This also resulted into the lack of financial resources for research. At the OMT of 3 October the advice was formed of publications in medical magazines to increase knowledge and to make Q-fever notifiable for animals before lambing season of 2008 (van Dijk et al, 2010). There should also come a multidisciplinary research agenda for the short and medium term questions. In the BAO it was decided that an inventory on hygienic measures would be done, EL&I had to come up with a proposal to collect data about the spread among animals and the GGD must prepare information to send to the public. On 25 October the Director food quality and animal health reported that there was still insufficient information to decide about making Q-fever notifiable in animals (van Dijk et al, 2010).

Some measures and starting research

In March 2008 the results of the epidemiological study - carried out by the RIVM - about the cause of the Q-fever outbreak in Herpen (North Brabant) shows that the bacteria spread through the air and that the source must be on the east-side of Herpen (a milk goat farm is present in that region that suffered from abortion problems caused by Q-fever) (van Dijk et al, 2010). Following studies did not immediately focussed on goat farms, they investigated divergent potential sources that were described in literature. A test to prove bacteria in abortion material that was developed by the GD, led to the conclusion that goat farms were seen as the likeliest source. The CIb reported 22 new patients in 2008 up to 7 April. Up to 29 May the GGD received a total of 75 confirmed human cases (van Dijk et al, 2010). The GD developed a test to verify the source. Later research showed that there were already more Q-fever cases in humans in 2005 and 2006 but this was not reported. On the 3rd of June the OMT formed an advice that making Q-fever notifiable is priority (van Dijk et al, 2010). This was not done yet because no measures or risk factors were available yet, but from the human side there was a lot of misunderstanding why this has not happened already. In the BAO it was reported that there were 149 human cases from 1 January up to 1 June 2008, while there were 196 cases in whole 2007 (van Dijk et al, 2010). It is discussed that goat farms are the most probable source and that EL&I must examine the possibility to make

Q-fever notifiable. On 12 June Q-fever was made notifiable in sheep and goats. Also it was not allowed to remove manure from the barn within 90 days after a Q-fever diagnosis. This measure was based on knowledge from Germany about manure. When later research from the Netherlands provided more insight, the days were reduced to 30. Besides that only inevitable visitors were allowed on the farm within 90 days after Q-fever diagnosis, this measure was based on experience, not on scientific information that it would reduce Q-fever from spreading.

On 22 July an international consultation was being held for questions that existed on blood donation and Q-fever in pregnancy (van Dijk et al, 2010), no veterinary experts were involved. It showed that experts from Australia looked differently at the Q-fever problem, they were wondered about all the fuss because from their perspective there were relatively so little patients yet. They also wanted to know why the Dutch government did not started with the vaccination of humans instead of animals, although they did acknowledge that the Australian situation was different from the Dutch. The expert told that in the Netherlands they talk about how much sheep there are per square kilometre, while in Australia they talk about how much square kilometre there is per sheep. The OMT formed an advice on 30 July that goat farms are the most plausible source, goat farms within a 10 km radius with the highest incidence will be visited to inventory the follow up of hygienic advice, removing manure is only allowed from barns when aerogenous spread has been made impossible, and vaccination would be inventoried. The advice is followed in the BAO and also hygienic information would be given towards non-commercial goat farms (van Dijk et al, 2010).

Also in July the head of infection disease control of the GGD HvB – J. van de Sande – was agitated when he thought that public health was subordinate to agriculture and that it was a matter of compromising between both ministries. At the same time the DG of VWS (at that time de Goeij) corrected him multiple times on what the correct way was when new information was found because they saw this occur in the media while they were not informed yet. On 16 October the exemption for the Coxevac-vaccin was granted. Now goat farmers within a 45 km radius of Uden could vaccinate voluntarily. During the vaccination campaign the efficacy of the vaccine was studied because not everything was known, it was a precaution measure. Also German experts on manure were consulted. On 19 November the expert deliberation is a new group, called in by the CIb. They were asked to assess the combat of Q-fever. The results on 4 December conclude that not all hygienic measures could be implemented in practice, some did not contribute to the prevention of spread and some effective measures were not present in the protocol (van Dijk et al, 2010).

The need for more research results and more measures

In a BAO on 14 January it was decided that vaccination should be mandatory for all professional milk goat or milk sheep farms (with more than 50 animals) and farms with a public function. The vaccination has to be administered before mating, all other farmers with goats or sheep could vaccinate on voluntarily basis. The former 45 km radius around Uden was expanded to the whole province of North Brabant. On 2 February it was decided that the hygienic plan for goat or sheep farms would be compulsory for every farm. In March Australia published their findings of the vaccination program in humans, the vaccine showed to be effective. On 20 April it is made mandatory to vaccinate goats or sheep on farms with more than 50 animals and on farms with a public function, before 1 January 2010. In the OMT of 11 May 357 new cases (from January 2009 up to 11 May 2009) were reported. The advice was to provide a uniform packet of preventive measures to medical professionals, public, managing staff and policy makers in regions where vaccination is compulsory. Possibilities for a transport ban had to be inventoried, and the possibilities for adaptations in buildings to prevent aerogenous spread of the bacteria. A transport ban was based on experience with other diseases. In the following BAO it was decided that in regions where compulsory vaccination was applied for animals the GGD had to present a packet of preventive measures and information to (medical)

professionals, public, local directors and policy makers. Further research was done on a movement ban, but first results of a transport ban research were awaited. The possibilities for building adaptations will be examined on short notice said EL&I.

Results of a manure research indicated on 11 June that there was still uncertainty on this topic, so infected farms should burn or sterilise their manure, industrial composting of manure of non-infected farms must be allowed, and bio-gasification was not allowed. In a letter from the GGD that was sent on 15 July to EL&I, the GGD concluded that despite all measures there was no decrease, but an increase in cases. They ask for new measures (van Dijk et al, 2010). Roel Coutinho from the RIVM also sent a letter on 24 July to both ministries. He said that more severe measures were needed to make the number of patients decrease. On 18 September parliamentary questions asked by the PvdD (partij voor de dieren/ party for the animals) were answered by the minister of EL&I: The exact location of infected farms would not be helpful in protecting public health and experts were asked to look at the definition of an infected farm. On 10 September the minister of EL&I answered to the GGD that infection was based on repeated PCR in milk and abnormal numbers of abortions (>5%) must be reported. On 10 October it is decided that it is mandatory to test milk on every goat or sheep farm every two months. There is a transport ban and a visitors ban for every infected farm. Vaccinated animals were allowed to enter the farm (van Dijk et al, 2010). In October 2009 the policy side (VWS & EL&I) made some scenario's and asked the experts for advice how sure it was for every scenario that Q-fever cases would decline. The expert deliberation discussed on 11 and 30 November the scenario's of for example prolonged milking without lambing, a breeding ban, eradication, vaccination (van Dijk et al, 2010). The RIVM was surprised about these scenario's because some were never brought up by experts as real opportunities. The experts advised eradication.

In the program Nova of 30 October Coutinho explained that he sent a letter to the ministries in July but this was not received enthusiastic because severe measures will touch upon the benefit of farmers. The ministries declared that they did followed the advices of Coutinho. On 1 December the 55th farm is infected. The Zembla broadcast (program searching for the truth) of 6 December showed a lot of critique about how the economic interest is being preferred above public health. On 7 December the Lower House demanded clarity on measures (van Dijk et al, 2010). During this period combating Q-fever switched from risk control towards precaution. On 9 December a public website was launched with information about Q-fever. It was decided that pregnant goats (infected or not, because they have shedding-free periods) on infected farms would be eradicated. It was prohibited to expand the number of goats or sheep per location (van Dijk et al, 2010). Also a breeding ban was implemented as precaution, this measure was also not based on scientific information that it would reduce Q-fever from spreading, but if it was implemented earlier, eradication could have been prevented. On 14 December the frequency of milk tests was increased to every two weeks. Vaccination was compulsory for every goat or sheep in the Netherlands. Even some other species had to be vaccinated. Also companies that present lambs in the spring for children had to vaccinate. A ban on cleaning barns within 30 days after the lambing period was implemented. It was also compulsory to store manure on farms for 90 days. On 18 December it was decided that it is not allowed to expand the number of goats or sheep on farms. The breeding ban would be applied to all farms with more than 50 milk animals. Lambs from infected farms may not be transported. On 21 December they started to eradicate goats on infected farms (van Dijk et al, 2010).

Sharpening the measures

On 1 January the implementation of a nationwide vaccination requirement started. On 5 January the expert deliberation advised on detection methods, treatments and prevention. On 6 January the minister of EL&I sent a letter to the Lower House as an update: there were up until then in total 61 infected farms and 8,724 animals eradicated on 21 farms. A protocol with hygienic measures would be implemented on children's

farms and other small companies. To enhance communication all people had access to a personal weblog and Twitter (van Dijk et al, 2010). Because research showed that within a 5 kilometre radius the chance of getting infected is higher, people in this radius around an infected farm would be informed to pay attention on symptoms they might develop. This was also based on research that showed that when people know they live in a region with a positive farm they will go faster to the general practitioner and have faster an adequate treatment than people that do not have such information. Also general practitioners are more aware of the fact that it can be Q-fever, so the diagnosis will be made faster. On 14 January the minister of EL&I answered parliamentary questions of the PvdD; there was no epidemiological evidence that children's farms are a risk for residents, residents of infected farms would be informed, and about 70% of all goat farms were free of Q-fever (van Dijk et al, 2010). A study at children's farms carried out by the NVWA led to discussion because it looked like the focus was shifted from livestock to children's farms but the RIVM thought that this could never be the problem. A day later the minister answered other parliamentary questions of the PvdD; a breeding ban was not considered in 2008 because this was not proportional and experts did not advice it, a breeding ban in the summer of 2009 was not implemented, and the Zembla broadcast was not the reason to start with other measures.

In a letter on 26 January from the ministers of EL&I and VWS they reported that eradication was implemented because in October the distinction between infected and non-infected farms could be made by milk tests. There were then 64 infected farms (1 sheep farm) on all farms pregnant animals were eradicated. The hygienic measures for children's farms were that they should keep pregnant animals in quarantine, lambing should be separate, it was not allowed for visitors to come into contact with pregnant animals from 4 months prior to, and 2 weeks after lambing. On 29 January the breeding ban was extended to rearing farms with more than 50 milk animals. On the expert deliberation of 15 February the topic of meat sheep was discussed and the size of the human epidemic. On 18 February it becomes known that the total number of human cases for 2009 is 2,368 (2,222 confirmed cases, 121 probable cases, and 25 with an unknown status). From 1 January 2010 up to 18 February there were 43 cases reported. On 23 February the regulation I&R (Identification and Registration) was changed. Now farmers of vaccinated animals had to report data per April the 1st into this system. In a letter on 24 February from the ministers of EL&I and VWS, the Lower House is informed about the fact that 75 farms were infected and 43,200 animals were eradicated. Companies with a public function also had to vaccinate their animals and implement a hygienic protocol. On 1 March an emergency debate was held; the government policy was highly criticized for not prioritizing public health. On 5 March the experts deliberation advised on the efficacy of vaccination, animals have a smaller chance of infection, it prevents abortion and shedding of the bacteria during abortion is reduced. On 22 March a lifelong ban on breeding with positive buck was implemented. On the same day the Lower House was informed by a letter from the minister of EL&I and VWS that there were 77 farms infected and 45,000 animals eradicated. The breeding ban expired on 15 May. Farms with more than 50 animals had to vaccinate before 1 June. The manure and hygienic measures held up, as well as the discharge prohibition of manure.

A letter of 11 May from the ministers of EL&I and VWS to the Lower House reported 88 infected farms and 62,500 eradicated animals. On 28 May the mandatory vaccination was extended to breeding animals and companies with a public function. On 15 July the frequency of milk samples was reduced to ones every 2 months (van Dijk et al, 2010). Farmers were allowed to breed and transport their animals again because all goat and sheep were vaccinated twice. The 92nd infected farm had been identified, but like the 90th farm no eradication was necessary because no pregnant animals were present. Up until July in the year 2010 there were 420 new patients with Q-fever. Five of the patients (that also suffered from another disease) were deceased (van den Brink, 2010a). On 20 August the breeding ban was set partly back into force because the animals that were born that year could have been infected. These animals could not be used for breeding,

even if they were vaccinated (NOS, 2010b; Food quality and Animal health management, 2010). On 17 November it became known that of all human cases 12 people died of Q-fever (NOS, 2010c). Up until 26 November the RIVM reported 15 (8 from 2008) people that are deceased due to Q-fever. All patients also suffered from other diseases. In humans there were 4000 reported cases (NOS, 2010a). On 15 December general practitioners received a letter with information about the vaccination of risk groups. This measure was based on findings of the Australia vaccination campaign that published their results in March 2009.

Appendix 8. Foreign knowledge on Q-fever

Before the outbreak in the Netherlands occurred, little was known about a lot of aspects of the disease. What was known was that Q-fever is a zoonosis, that it occurred endemically in the Netherlands, that the vaccine in animals could not prevent all infections of Coxiella but it would reduce shedding and prevent abortion, that certain outbreaks could become very big, the bacteria was not influenced much by the environment, that it could spread by air, that abortion material could be a potential source because it contained high concentrations of bacteria, that clusters of people could become ill, and which humane experts could be involved. What was unknown was how the disease would develop, if small ruminants were the source in this situation, that the outbreak could return the next year, precise transmission information, bacteria characteristics and veterinary experts that could be involved. At the beginning of the outbreak all knowledge on Q-fever outbreaks from other countries were analysed for useful information. Different countries had experience with the following measures, although the efficacy was not known: disposing risk material from the barn, reducing the number of visitors on the farm, composting manure or a treatment with chemicals, and a transport ban. A breeding ban or eradication of positive animals has never been used by other countries (van Dijk et al, 2010). Most literature that was present at the start of the outbreak came from France. Here were also some humane and veterinary experts present. According to Dutch scientists it was difficult to explain the Dutch situation to them, and for them it was difficult to properly advice on the Dutch situation. France already had long experience with vaccination. The effectiveness of the vaccine was however not sufficient in pregnant animals (Arricau-Bouvery et al, 2005). In Germany there was some expertise on manure that was consulted and they also had some protocols for measures, but these were rather based on assumptive efficacy and empiricism than on proven efficacy. Some hygienic measures were adopted in the Dutch approach. There was no uniformity about the treatment of Q-fever.

With all information described above it seems that there was a lot of knowledge and experience abroad. From this the most important fact was that aborting and lambing in sheep or goats was found in many outbreaks the most plausible source of infection. But also that a lot of literature described outbreaks that persisted for only one year and mostly occurred after contact infection. There were also many outbreaks described among animals that did not transferred to humans at all (van Dijk et al, 2010). Outbreaks abroad were described as being a lot different than what was happening in the Netherlands. The outbreaks described were incidental and point source and not seasonal, so also never severe measures were necessary.

"Disease control measures were abroad always focussed on point source, a single outbreak. That is of course easy to fight" [22] *(Representative NVWA).*

"They did not need to take serious measures to prevent following outbreaks" [23] *(Representative CVI).*

Besides that, the fact that the Netherlands also has a large goat sector made it difficult to compare the event with other countries.

"We have a unique type of goat husbandry, intensive in scale, and in deep litter barns. Also the fact that it is all very close to habituation, was special. In many other countries

[22] "Bestrijdingsmaatregelen zijn in het buitenland altijd gefocust geweest op 'point source', een enkele uitbraak. Dat is natuurlijk wel makkelijk bestrijden."

[23] "Ze hadden niet de noodzaak om zware maatregelen te nemen om volgende uitbraken te voorkomen."

there is much more space between farming activities and urbanization, so that made it very difficult to compare" [24] *(Representative RIVM).*

According to Dutch animal scientists literature therefore was almost never useful.

[24] "Wij te maken hadden met een vrij unieke vorm van geitenhouderij, intensief qua schaalgrootte en in potstallen. Ook het feit dat het allemaal heel dicht bij de bewoning was, dat was bijzonder. In heel veel andere landen is veel meer ruimte tussen dierhouderijen en verstedelijking, dus dat maakte dat het gewoon heel moeilijk te vergelijken was."

Appendix 9. Foreign measures on Q-fever

Arricau-Bouvery et al presented results in 2005 of a study they performed with 2 types of vaccination, named phase 1 and phase 2. These phases refer to the transformation of *C. burnetii* from a virulent phase towards an avirulent phase. Phase 1 vaccination showed to be suitable in the prevention of abortion in goats and excretion of bacteria in milk, vaginal mucus and faeces after infection. The effectiveness of the vaccine was however not sufficient in pregnant animals (Arricau-Bouvery et al, 2005). In Germany there was some expertise on manure that was consulted and they also had some protocols for measures, but these were rather based on assumptive efficacy and empiricism than on proven efficacy. Some hygienic measures were adopted into the Dutch approach. There was no uniformity about the treatment of Q-fever.

Experience in the treatment with antibiotics has been present both in Germany and in France. There has been found no proof that the excretion could be reduced. Experience with diagnostic tests was present in several countries. The tests that were available before the outbreak could identify the causative bacteria *C. Burnetii* in abortion material, birth products, vaginal swabs, milk and faeces. The Polymerase Chain Reaction (PCR) test, which is the most reliable test was already used in France very often (van Dijk et al, 2010). As it does not test for antibodies the test can be used early after infection (Porter et al, 2011; de Bruin et al, 2011). The test itself is very reliable although animals that are sampled in an excretion-free period will be missed (van Dijk et al, 2010). The RIVM was also working on the development of a PCR test before the outbreak. Serological tests were also available, but they are not as reliable as the PCR test. This is because they measure the antibodies an animal has produced against *C. burnetii*, so an animal can be infected with *C. burnetii* while not showing antibodies (yet), or an animal shows antibodies while it is no longer infectious (Porter et al, 2011). The most common used serological tests are the Indirect Immunofluorescence Test (IFT) and Enzyme-Linked ImmunoSorbent Assay (ELISA) (van Dijk et al, 2010).
In 2006 the European program, MedVetNet, started and had on coincidence a work package on Q-fever, knowledge about methods for the detection of Coxiella burnetii in animals and the environment were present in the laboratory, although not validated for a certain situation.

Appendix 10. Structure in the approach of infectious diseases in Australia

An outbreak or unusual incident must be reported. When State and Territory officers notice such messages, they inform the situation to their CVO. The CVO can decide to take measures to prevent the disease from spreading. The CVO can discuss the problem with the Australian CVO from the Australian Government DAFF and they decide whether it requires a national response (Post et al, 2004). When a disease outbreak occurs, the AHC becomes the Consultative Committee on Emergency Animal Diseases (CCEAD) (Stratton et al, 2006). The CCEAD is a sub-committee under the Primary Industries Standing Committee (PISC) (Post et al, 2004). This group is chaired by the ACVO and will further include people from the affected sector and members of the relevant disease or specie. In case of a zoonosis the Australian Chief Medical Officer (CMO) will participate (Stratton et al, 2006). The ACVO can call in a meeting at the time it is necessary, a rapid consultation is possible (Post et al, 2004). The CCEAD provides the technical link for decision making during outbreaks (Stratton et al, 2006). At meetings the physical and financial resources, laboratory results, the pattern of the spread of the disease and control measures are discussed. Their task is to coordinate and make decisions in the approach to emergency animal disease incidents that includes animal health, but also public health. They will do this for as long as the event exists (Post et al, 2004).
In certain diseases the CCEAD acts under the Emergency Animal Disease Responses (EADRA). The EADRA is an agreement between Animal Health Australia, the Australian Government, all State and Territory governments and livestock industry signatories (Post et al, 2004). The National Emergency Animal Disease Management Group (NMG) is under the EADRA and has to review the advice that is given by the CCEAD (Australian Government; DAFF, 2012). The NMG has the task to invoke the cost sharing arrangements. This task is carried out by chief executives of Australian State and Territory governments' primary industries departments, and chief executives of the affected industry. The NMG is chaired by the Chief Executive of the Australian Government DAFF. The NMG can make recommendations in prevention or control to prevent potential threats to become a problem. These recommendations on policy issues can be considered in the PIMC.

The Department of Health and Ageing (DoHA) is responsible for public health, health protection and medical research (Australian Government; DoHA, 2012b). Together with the DAFF they coordinate the response to the disease, coordinate communication, are responsible for access to overseas trading markets, and for surveillance and intelligence on the disease. They also report to the World Organisation for Animal Health (OIE) (Post et al, 2004). For the protection of public health the DoHA has the division Office of Health Protection (OHP). The OHP is the coordinator of national action when an outbreak of a communicable disease occurs. The OHP develops guidelines and forms policy on national public health. By national and international networking they get expertise on communicable diseases and related fields. By close cooperation with the Australian Quarantine Inspection Service, the DAFF and the Food Standards Australia New Zealand a timely response to disease outbreaks is ensured. Organisations like the Kirby Institute for infection and immunity in society and the National Centre for Immunisation Research and Surveillance of Vaccine Preventable Diseases (NCIRS) carry out research for the OHP (Australian Government; DoHA, 2012b).

The Communicable Diseases Network Australia (CDNA) provides a national public health perspective. The CDNA is involved in surveillance, prevention and control. They take decisions and inform the government and other organisations involved in communicable diseases. They also develop and coordinate surveillance programs (Australian Government; DoHA, 2012b). CDNA members, including members from other specialist organisations, meet on regular basis to discuss the approach of communicable diseases. In case of a zoonosis an animal health representative from DAFF will also be present at meetings. This person will provide inputs from the animal health perspective and report

to animal health authorities (Stratton et al, 2006). The CDNA is a subcommittee of the Australian Health Protection Committee (AHPC). The AHPC advices the Australian Health Ministers' Advisory Council (AHMAC) on the preparedness for health emergencies (Australian Government; DoHA, 2012b).

Besides the two governmental departments there are also other organisations involved in animal diseases. Also animal industry groups are responsible for animal health. They must develop plans to prevent the disease from spreading. Local government departments will also have to contribute by being prepared, response and performing recovery activities in their region. State and Territory governments are responsible for certain measures such as quarantine and movement bans. They also perform surveillance activities and carry out investigations. All organisations must report suspected outbreaks (Post et al, 2004).

Appendix 11. Notable outbreaks of Q-fever in Australia

From its discovery up to 1957 there have been 112 cases of *C. burnetii* infections reported in humans. Until 1954 all cases occurred in meat workers in South Australia. In this year an outbreak of 11 Q-fever cases were associated with sheep contact. In 1956 a case occurred that was related to kangaroos. An outbreak of 52 people occurred in 1957, most of these patients were meat workers (Beech et al, 1962). After that the Q-fever notifications lie between 100 and 900 patients each year. Only clusters of patients are referred to as outbreaks (GIDEON, 2011).

In 1969 Q-fever causes infection in 7.9% of the workers in a Brisbane 'meat works'. Ten years later, an abattoir in Victoria reports an outbreak of 110 cases (GIDEON, 2011). In 1998 29 cases and 8 suspected cases of the 103 employees of an abattoir were reported after and during the vaccination period in Victoria. Results showed that this happens when the vaccination is administered in the incubational period of a natural infection. The real source of the infection was suspected to be infected pregnant cattle from an endemic area. Since the vaccination, Q-fever after vaccination has occasionally been reported (Gilroy et al, 2001). From 1998 to 2000 the Townsville General Hospital reported an unexplained increase in infections of acute Q-fever. 4 of the 19 patients could be linked to risk factors, 2 worked with cattle and livestock, 1 worked at an abattoir and 1 recently helped the birth of a calf. But no geographical clustering or seasonal link could be identified. Cases where no occupational link can be made are not uncommon (Chong et al, 2002).

Since 1999 the number of Q-fever infections has increased until 2002. As in previous years, notification rates were between 2003 and 2005 highest in Queensland and New South Wales (Australian Government; DoHA, 2012a). In 2003 550 cases were reported, whereof 502 from New South Wales and Queensland. There were in total 6 clusters of patients. 5 clusters occurred in Queensland, whereof 4 had 2 to 3 cases occurring all in the family. The other case was linked to a goat farm where 5 people got sick (Miller et al, 2005). In 2004 there were 10 reported cases of Q-fever in New South Wales in a shearing team (Massey and Taylor, 2004) and 9 confirmed and 6 suspected cases among farmers in South Australia (GIDEON, 2011). In 2005 an outbreak occurred in a factory that processes material for the cosmetic industry. These materials contained powdered sheep placentas and fetal tissues. For years this never caused infection in the 8 people that worked there. When in 2005 a change was made in the processing method of these products, four cases of acute Q-fever occurred within 30 days of the change. Currently also people that work with such materials are vaccinated (Wade et al, 2006). Another outbreak in 2005 occurs among people that were involved in calving activities in New South Wales. 5 people got sick (GIDEON, 2011).

In 2006 there was an outbreak of 27 patients and a cluster of 5 patients that lived near an abattoir that slaughtered goats (GIDEON, 2011; Australian Broadcasting Corporation, 2007). Both outbreaks occurred in South Australia, though Queensland and New South Wales report over 90% of all cases (GIDEON, 2011). While the national average is 1.4 cases per 100,000, the rate in 2007 was in New South Wales 3.15 (Massey et al, 2009a). New South Wales is the most populous state (Massey et al, 2009a) and here the cases increased from 143 patients in 2005, to 175 in 2006 and to 215 in 2007. Most cases occurred west in the rural areas (GIDEON, 2011). Queensland has a low population density, is very wide and has historically been used as grazing sites for cattle. Only nowadays there are very few cattle and the area is inhabited by many wildlife species (Harris et al, 2012).