ENVIRONMENTAL HEALTH WORK METHODS AND PROCEDURES FOR THE SURVEILLANCE AND CONTROL OF AVIAN INFLUENZA IN THE EASTERN CAPE PROVINCE, SOUTH AFRICA

By

SAMMY ABRAHAM ELIE

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TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>ii</td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td>iii</td>
</tr>
<tr>
<td>LIST OF ANNEXURES</td>
<td>x</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>xii</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xiii</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>xiv</td>
</tr>
<tr>
<td>KEY WORDS</td>
<td>xv</td>
</tr>
<tr>
<td>CHAPTER ONE: INTRODUCTION</td>
<td></td>
</tr>
<tr>
<td>1.1. Literature review</td>
<td>1</td>
</tr>
<tr>
<td>1.2. Problem statement</td>
<td>8</td>
</tr>
<tr>
<td>1.2.1. Sub problems</td>
<td>8</td>
</tr>
<tr>
<td>1.2.1.1. The organisational arrangements of avian surveillance</td>
<td>8</td>
</tr>
<tr>
<td>and control in South Africa</td>
<td></td>
</tr>
<tr>
<td>1.2.1.2. The epidemiology of avian influenza</td>
<td>9</td>
</tr>
<tr>
<td>1.2.1.3. Work methods and procedures for the surveillance</td>
<td>9</td>
</tr>
<tr>
<td>and control of avian influenza</td>
<td></td>
</tr>
<tr>
<td>1.3. Purpose of the study</td>
<td>10</td>
</tr>
<tr>
<td>1.4. Significance of the study</td>
<td>10</td>
</tr>
<tr>
<td>1.5. Theoretical framework</td>
<td>11</td>
</tr>
<tr>
<td>1.6. Research methodology and design</td>
<td>13</td>
</tr>
<tr>
<td>1.6.1. Research methodology</td>
<td>13</td>
</tr>
<tr>
<td>1.6.2. Research design</td>
<td>14</td>
</tr>
<tr>
<td>1.6.2.1. Exploratory research</td>
<td>14</td>
</tr>
<tr>
<td>1.6.2.2. Descriptive research</td>
<td>14</td>
</tr>
<tr>
<td>1.6.2.3. Inductive research</td>
<td>15</td>
</tr>
<tr>
<td>1.6.2.4. Deductive research</td>
<td>16</td>
</tr>
<tr>
<td>1.6.3. Study population</td>
<td>16</td>
</tr>
<tr>
<td>1.6.4. Sampling</td>
<td>16</td>
</tr>
<tr>
<td>1.6.5. Data collection</td>
<td>18</td>
</tr>
</tbody>
</table>
1.6.5.1. Documentary research ............................................. 18
1.6.5.2. Group of experts .................................................. 19
1.6.5.3. Telephonic questionnaire ....................................... 20
1.6.5.4. Personal interviews ............................................... 20
1.6.6. Entry to workplaces of participants ............................ 22
1.6.7. Data analysis .......................................................... 23
1.7. Trustworthiness ............................................................ 24
1.7.1. Credibility ............................................................... 25
1.7.2. Transferability ......................................................... 25
1.7.3. Dependability .......................................................... 26
1.7.4. Conformability ......................................................... 26
1.8. Ethical considerations .................................................... 26
1.9. Pilot study ....................................................................... 27
1.10. Plan of the study .......................................................... 27
1.11. Clarification of key concepts ....................................... 29
1.11.1. Municipal health services ....................................... 29
1.11.2. Avian influenza ....................................................... 30
1.11.3. A human avian influenza outbreak ........................... 30
1.11.4. Avian influenza surveillance ................................. 31
1.11.5. Avian influenza control ......................................... 31
1.11.6. Work methods ......................................................... 31
1.11.7 Work procedures ...................................................... 31

CHAPTER TWO: AVIAN INFLUENZA: THE PLACE AND ROLE OF ENVIRONMENTAL HEALTH IN THE NATIONAL, PROVINCIAL AND MUNICIPAL SPHERES OF GOVERNMENT

2.1. Introduction ..................................................................... 33
2.2. The Environmental Health profession .......................... 33
2.2.1. Environmental Health defined ................................ 34
2.2.2. The functional areas of environmental health service delivery 36
2.2.3. Professional regulatory framework and requirements 39
2.3. The place and role of environmental health within the organisational structure of the health care system in South Africa

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.3.1.</td>
<td>Legislation relevant to health care service delivery in South Africa</td>
<td>42</td>
</tr>
<tr>
<td>2.3.1.1.</td>
<td>Constitutional imperatives relevant to health care service delivery in South Africa</td>
<td>42</td>
</tr>
<tr>
<td>2.3.1.2.</td>
<td>The significance of the National Health Act, 2004 (Act 61 of 2003)</td>
<td>43</td>
</tr>
<tr>
<td>2.3.1.3.</td>
<td>Legislation relevant to avian influenza in South Africa.</td>
<td>45</td>
</tr>
<tr>
<td>2.3.2.</td>
<td>The organisational structure of the National Department of Health</td>
<td>47</td>
</tr>
<tr>
<td>2.3.2.1.</td>
<td>The Minister of Health and the Cabinet</td>
<td>48</td>
</tr>
<tr>
<td>2.3.2.2.</td>
<td>The National Health Council</td>
<td>49</td>
</tr>
<tr>
<td>2.3.2.3.</td>
<td>The Director-General of Health</td>
<td>50</td>
</tr>
<tr>
<td>2.3.2.4.</td>
<td>National Consultative Health Forum</td>
<td>51</td>
</tr>
<tr>
<td>2.3.2.5.</td>
<td>The Deputy Director-General of Health</td>
<td>52</td>
</tr>
<tr>
<td>2.3.3.</td>
<td>The place and role of environmental health within the National Department of Health</td>
<td>53</td>
</tr>
<tr>
<td>2.3.4.</td>
<td>The organisational structure of the Provincial Health Departments</td>
<td>55</td>
</tr>
<tr>
<td>2.3.4.1.</td>
<td>A Provincial Health Department</td>
<td>56</td>
</tr>
<tr>
<td>2.3.4.2.</td>
<td>Member of the provincial executive committee responsible for health and the provincial legislature</td>
<td>56</td>
</tr>
<tr>
<td>2.3.4.3.</td>
<td>Provincial Health Council</td>
<td>57</td>
</tr>
<tr>
<td>2.3.4.4.</td>
<td>Chief Directorate: District Health Services</td>
<td>59</td>
</tr>
<tr>
<td>2.3.5.</td>
<td>The place and role of environmental health within the Provincial Health Departments</td>
<td>61</td>
</tr>
<tr>
<td>2.3.6.</td>
<td>The organisational structure of the District Health System</td>
<td>63</td>
</tr>
<tr>
<td>2.3.6.1.</td>
<td>The District Health System</td>
<td>63</td>
</tr>
<tr>
<td>2.3.6.2.</td>
<td>Health District</td>
<td>65</td>
</tr>
<tr>
<td>2.3.6.3.</td>
<td>District Health Council</td>
<td>66</td>
</tr>
<tr>
<td>2.3.6.4.</td>
<td>A Health Sub-district</td>
<td>67</td>
</tr>
<tr>
<td>2.3.6.5.</td>
<td>A Local Municipality</td>
<td>69</td>
</tr>
</tbody>
</table>
2.3.7. The place and role of environmental health within the district health system ........................................................................................................ 70

2.4. Conclusion .................................................................................................................. 72

CHAPTER THREE: THE EPIDEMIOLOGY OF AVIAN INFLUENZA

3.1. Introduction ................................................................................................................. 77
3.2. Definition of Influenza............................................................................................... 77
3.3. Description of the influenza virus ............................................................................. 78
3.4. Classification of the influenza virus ......................................................................... 79
3.5. The mechanism of influenza virus variability ............................................................ 80
  3.5.1. Antigenic shift .............................................................................................. 80
  3.5.2. Antigenic drift ............................................................................................. 81
3.6. Difference between human seasonal influenza, avian influenza and human pandemic influenza ................................................................................................. 82
  3.6.1. Seasonal influenza ......................................................................................... 82
  3.6.2. Avian influenza ............................................................................................ 83
  3.6.3. Human pandemic influenza .......................................................................... 86
3.7. Natural hosts of the avian influenza virus ................................................................. 87
3.8. Sources of infection of the avian influenza virus ...................................................... 88
3.9. Clinical presentation of the avian influenza virus .................................................... 89
  3.9.1. Clinical features in humans ........................................................................... 89
  3.9.2. Initial symptoms in humans ........................................................................... 90
  3.9.3. Case definition for avian influenza in humans ............................................... 90
  3.9.4. Clinical signs of avian influenza in birds ....................................................... 91
  3.9.5. Differential diagnosis in animals ................................................................... 91
  3.9.6. The pathology of avian influenza .................................................................. 92
3.10. Transmission of avian influenza .............................................................................. 93
  3.10.1. Transmission of avian influenza between humans ....................................... 93
  3.10.2. Transmission of avian influenza from birds to humans ............................. 95
  3.10.3. Transmission of avian influenza from humans to humans ....................... 96
  3.10.4. Transmission of avian influenza in birds ..................................................... 97
  3.10.5. Risk of spreading the avian influenza in poultry and related
industries ................................................................................................................. 98
3.11. Incidences of avian influenza ........................................................................ 100
  3.11.1. Avian influenza incidences in the world .............................................. 100
  3.11.2. Epidemiological case investigations of human avian influenza .. 100
  3.11.3. Avian influenza incidences in South Africa .............................. 102
3.12. Risk assessment ............................................................................................. 102
  3.12.1. Estimated impact of a future influenza pandemic ..................... 104
    3.12.1.1. Impact on the health care system and infrastructure .... 105
    3.12.1.2. Impact on businesses .............................................. 106
    3.12.1.3. Impact of an outbreak of highly pathogenic avian influenza .................................................................. 106
  3.12.2. Mitigation of the impact of highly pathogenic avian influenza .. 107
3.13. Conclusion ................................................................................................... 107

CHAPTER FOUR: WORK METHODS AND PROCEDURES FOR THE SURVEILLANCE OF AVIAN INFLUENZA
4.1. Introduction ........................................................................................................ 113
4.2. Basic principles of human avian influenza surveillance.............................. 113
4.3 Human case surveillance ................................................................................... 116
  4.3.1. Case detection ......................................................................... 117
  4.3.2. Reporting of a notifiable disease .............................................. 120
  4.3.3. Investigation of an avian influenza outbreak ............................. 122
  4.3.4. Human case confirmation ......................................................... 124
4.4. Basic elements of avian influenza surveillance in birds .............................. 126
  4.4.1. Early detection of disease ................................................................. 128
  4.4.2. Clinical surveillance of birds ................................................................. 128
  4.4.3. Serological surveillance of birds ........................................................... 130
  4.4.4 Virological surveillance of birds .............................................................. 132
4.5. Conclusion ...................................................................................................... 133
# CHAPTER FIVE: WORK METHODS AND PROCEDURES FOR THE CONTROL OF AVIAN INFLUENZA

5.1. Introduction ........................................................................................................ 136
5.2. Basic strategies for avian influenza control ....................................................... 137
5.3. Control strategies for avian influenza in humans .............................................. 138
   5.3.1. Preventing the exposure of workers in health care facilities ..... 138
   5.3.2. Avian influenza control by vaccination .................................................. 140
   5.3.3. Avian influenza control by antiviral drugs .......................................... 142
   5.3.4. Avian influenza education ..................................................................... 143
   5.3.5. Legislative measures for the control of avian influenza ................. 145
5.4. Control strategies for bird avian influenza cases ............................................. 145
   5.4.1. Biosecurity ............................................................................................ 146
   5.4.2. Elimination of infected poultry ............................................................ 148
   5.4.3. Vaccination ........................................................................................... 148
   5.4.4. Avian influenza education .................................................................. 150
5.5. The role of Avian Influenza Endemic Outbreak Response Teams .......... 150
   5.5.1. The place and role of environmental health in the National Communicable Disease Outbreak Response Team ............... 151
   5.5.2. The place and role of environmental health in a Provincial Outbreak Response Team ...................................................... 153
   5.5.3. The place and role of environmental health in a Health District Outbreak Response Team ...................................................... 155
   5.5.4 The place and role of environmental health in a Health Sub-District Outbreak Response Teams ........................................ 158
   5.5.5. Frequency of meetings for outbreak response teams at the municipal sphere of government ............................................. 159
5.6. Conclusion ......................................................................................................... 160
# LIST OF ANNEXURES

| Annexure 1: | Letter: Request for permission to conduct telephonic interviews | 202 |
| Annexure 2: | Telephonic questionnaire schedule | 204 |
| Annexure 3: | Data analysis of the telephonic interviews conducted amongst the provincial communicable disease outbreak co-ordinators (the group of experts) | 213 |
| Annexure 4: | Personal interview schedule | 224 |
| Annexure 5: | Letter: Request for permission to conduct research | 225 |
| Annexure 6: | Information and informed consent form | 227 |
| Annexure 7: | Organogram of the National Department of Health | 230 |
| Annexure 8: | List of matters that the provincial legislature shares concurrent powers with parliament | 232 |
| Annexure 9: | Organogram of the Eastern Cape Provincial Health Department | 235 |
| Annexure 10: | Organizational Structure of Ukhahlamba District Municipality | 236 |
| Annexure 11: | Diagrams that illustrate the events during an antigenic shift and an antigenic drift | 237 |
| Annexure 12: | Instances of avian influenza infection in humans | 239 |
| Annexure 13: | Map of affected areas with confirmed human cases of H5N1 avian influenza since 2003 | 242 |
| Annexure 14: | Map of areas reporting confirmed occurrence of H5N1 avian influenza in poultry and wild birds since 2003 | 243 |
| Annexure 15: | Phases of pandemic influenza | 244 |
| Annexure 16: | Clinical features of human avian influenza | 247 |
| Annexure 17: | Active screening process for avian influenza | 249 |
| Annexure 18: | Initial diagnosis form for notifiable diseases: Form (GW 17/5) | 251 |
| Annexure 19: | Human avian influenza notification form | 252 |
| Annexure 20: | Work methods and procedures for human avian influenza specimen collection | 253 |
| Annexure 21: | Avian influenza investigation kit | 265 |
| Annexure 22: | Avian influenza infection control measures | 266 |
| Annexure 23: | Avian influenza-like illness monitoring form | 269 |
Annexure 24: Work methods and procedures for specimen collection during clinical surveillance of birds .......................................................... 271
Annexure 25: Work methods and procedures for specimen collection during serological surveillance of poultry ............................................. 278
Annexure 26: Schematic representation of laboratory tests for determining evidence of avian influenza infection of poultry flocks ................. 282
Annexure 27: Work methods and procedures for health care workers providing care to avian influenza infected patients at health care facilities ............................................................................................. 284
Annexure 28: Prevention and control advice for people living in areas affected by avian influenza .......................................................... 292
Annexure 29: Work procedures for biosecurity of poultry to prevent the introduction of avian influenza .............................................. 297
Annexure 30: Work methods and procedures for the elimination of infected poultry .................................................................................. 300
Annexure 31: Sectors that should serve on the National Avian Influenza Outbreak Response Team ...................................................... 305
Annexure 32: Sectors that should serve on the Provincial Avian Influenza Outbreak Response Team in the Eastern Cape province ........ 307
LIST OF TABLES

Table 1: Telephonic interview response rate ............................................... 213
Table 2: Training received by provincial communicable disease co-ordinators on the co-ordination of an avian Influenza outbreak 218
Table 3: Phases of pandemic influenza ............................................................ 244
Table 4: Sample strategy for poultry .............................................................. 278
LIST OF FIGURES

Figure 1: Case definition of avian influenza in humans ......................... 118
Figure 2: Work procedures to report human avian influenza cases ....... 121
Figure 3: Response procedures during an avian influenza outbreak ....... 124
Figure 4: Ages of the seven respondents ................................................ 214
Figure 5: Respondents years of work experience relevant to their current jobs ......................................................................................... 215
Figure 6: Respondents years of experience as provincial communicable disease co-ordinators in their own provinces .............................. 215
Figure 7: Educational attainment of respondents ................................. 217
Figure 8: Language proficiency of respondents .................................... 217
Figure 9: The presence of a provincial contingency plan to deal with an avian influenza outbreak .......................................................... 219
Figure 10: The level of preparedness of provincial health departments to deal with an avian influenza outbreak ...................................... 219
Figure 11: Taking of a throat sample ......................................................... 254
Figure 12: Swab techniques ...................................................................... 255
Figure 13: Taking of a nasopharyngeal swab sample ............................... 256
Figure 14: Performing a nasopharyngeal aspirate .................................... 257
Figure 15: Anterior nasal swab .................................................................. 257
Figure 16: Putting on a tourniquet to palpate and locate the vein .......... 259
Figure 17: Disinfection of the venepuncture site .................................... 259
Figure 18: Performing a venepuncture with a venepuncture system ....... 260
Figure 19: Drawing blood into a vacutainer serum-separator tube ........ 260
Figure 20: Applying pressure to the venepuncture site ......................... 260
Figure 21: Data collection form: avian influenza investigation of humans .. 263
Figure 22: Data collection form: avian influenza investigation of birds ..... 275
Figure 23: Placement of personal protective equipment, including surgical mask and goggles .................................................................. 287
Abstract

Avian influenza is an infectious disease of birds caused by the Type A strain of the influenza virus. The disease, which was first identified in Italy more than 100 years ago, occurs worldwide (World Health Organization, 2006a). The current outbreak of the highly pathogenic avian influenza A (H5N1), which began in Southeast Asia in mid-2003, is the largest and most severe on record. Never before in the recorded history of this disease have so many countries been simultaneously affected. Since the last pandemic in 1968-1969, the risk of an influenza pandemic has not been considered greater than at the present time. The importance of intervention strategies had become increasingly evident throughout the world. The World Health Organization provides a generic outline for preparedness plans to assist countries in their preparations to respond to a possible avian influenza pandemic. These guidelines may be modified as the epidemiology of avian influenza evolves.

The South African National Department of Health has developed national guidelines in the form of an avian influenza preparedness plan. These draft guidelines do not provide detailed Environmental Health work methods and procedures for the effective surveillance and control of the disease.

The general purpose of this study is to develop a standardised set of Environmental Health work methods and procedures, which will contribute to the effective surveillance and control of avian influenza in the Eastern Cape province – South Africa. Within the context of the purpose of this study, a qualitative, explorative, descriptive, inductive and deductive research design will be used. The methods of data collection will be documentary research, telephonic as well as in-depth personal interviews. In this study, documentary research will be the primary method of data collection. With a qualitative approach, the researcher will be the human instrument for data analysis. The process of qualitative data analysis will be based on data reduction and interpretation; and will be conducted as an activity simultaneously with data collection, data interpretation and narrative reporting writing.
KEY WORDS: Avian influenza; Surveillance; Control; Work methods; Work procedures.
1.1. Literature review

According to Taylor (2006, p.1), a literature review is an account of what has been published on a topic by accredited scholars and researchers. Creswell (2003, p.30) states that a literature review provides a framework for establishing the importance of the study as well as a benchmark for comparing the results of a study with other findings. With qualitative research, a literature review shows that the researcher has identified some gaps in previous research and that the proposed study will fill a demonstrated need (De Vos, Strydom, Fouché & Delport, 2002, p.263). The researcher will conduct a thorough search of useful and relevant information pertaining to the topic, with the aim of gaining knowledge and ideas for further research.

Avian influenza (also referred to as avian flue) is an infectious disease of birds caused by the Type A strain of the influenza virus. There is currently a widespread epidemic in Asia of highly pathogenic avian influenza, caused by influenza A (H5N1) in animal populations, particularly chickens, that poses a considerable public health risk. Avian flue is also a highly infectious viral disease that can infect humans, causing severe disease with high mortality. The virus has the potential to adapt, or recombine with other influenza viruses, that can give rise to a new viral strain which may have pandemic consequences (World Health Organization, 2005a, p.3).

While influenza pandemics are infrequent events, they are rightly feared as they spread very rapidly to affect all countries and cause abrupt and significant increases in morbidity. Neither the timing, nor the severity of the next pandemic can be predicted, but severe pandemics in the past have resulted in tens of millions of deaths. Since the last pandemic in 1968-1969, the risk of an influenza pandemic has not been considered greater than at the present time (World Health Organization, 2005a, p.2).
Avian influenza is a highly infectious viral disease that can affect all species of birds. The avian influenza virus spreads through migratory birds, but what is most alarming is the concern that avian flu could become a possible pandemic. The severity of disease depends upon the strain and subtype of virus and the type of bird infected. There are three types of influenza virus: A, B, and C. Type A and B cause the most severe illness. Avian influenza is an infectious disease caused by type A strains of the influenza virus. Influenza A viruses can be divided into subtypes on the basis of their surface proteins - hemagglutinin (HA) and neuraminidase (NA). There are 16 known HA subtypes (H1-H16) and nine NA subtypes (N1-N9). Any number of combinations are possible, as each virus has one HA and one NA antigen (Canada Food Inspection Agency, 2006, p.1).

The avian influenza virus can be grouped into two categories, based on the severity of the illness in birds. The Highly Pathogenic Avian Influenza (HPAI) viruses have the potential to cause severe disease in poultry, associated with a high death rate (up to 100%); the course of such disease can be so rapid, the birds may die without showing signs of the disease. Infection with Low Pathogenic Avian Influenza (LPAI) viruses usually results in milder, less virulent disease. However, some LPAI viruses can mutate into highly pathogenic strains (Canada Food Inspection Agency, 2006, p.1).

The current outbreak of Highly Pathogenic Avian Influenza A (H5N1), which began in Southeast Asia in mid-2003, is the largest and most severe on record (World Health Organization, 2006a). Past influenza pandemics have led to high levels of illness, death, social disruption and economic loss. There were three pandemics in the 20th century; the Spanish flu (1918-1919), Asian flu (1957-1958), and Hong Kong flu (1968-69). All of them have spread worldwide within a year of being detected (Kamps & Reyes-Teran, 2006, p.2).

The widespread persistence of H5N1 in bird populations poses two main risks to human health. The first is the risk of infection when the virus spreads
directly from birds to humans. The second risk, which is of even greater concern, is that there will be increased possibilities for the widely circulating virus to infect humans and possibly reassort into a strain that is both highly infectious for humans that may spread easily from human-to-human. The accumulation of point mutations or reassortment with a human influenza virus could lead to increased transmissibility of the virus at any time. Such a change could mark the start of a new pandemic (World Health Organization, 2006c, p.5).

Direct or indirect contact between domestic flocks and wild migratory waterfowl has been implicated as a frequent cause of epidemics in poultry populations. It is generally accepted that migratory waterfowl, most notably wild ducks, are the natural reservoir of avian influenza viruses, which can be transmitted to domestic bird populations and to commercial poultry. In the absence of good surveillance and prompt control strategies, avian influenza epidemics can last for years (World Health Organization, 2006b, p5).

Transmission of avian influenza viruses to people remains relatively rare and in most cases occurs as a result of direct contact with infected poultry or other birds or their faeces. Faecal material can contaminate dust, soil, water, feed, equipment, clothing and feathers. Transmission to people only occurs with certain strains of avian influenza (Hien, et al., 2004, p.1179). Information about the current outbreaks of avian influenza is available on the World Health Organization's website at: http://www.who.int/csr/disease/avian/influenza/chronology/en.

The first human cases of avian influenza A (H5N1) associated with the current outbreak in birds were confirmed in January 2004, after clinical samples taken from two children and one adult admitted to a hospital in Hanoi (Vietnam) with severe respiratory illness tested positive for the strain (Hien, et al., 2004, p.1179). Since then, other human cases have occurred in several countries, and the clinical spectrum of the infection ranges from asymptomatic to a

According to the World Health Organization (2006d) there is evidence that the H5N1 strain of the bird flu virus - which has been circulating in birds - has a unique capacity to mutate and jump the species barrier causing a disease with high mortality in humans. The first priority - according to the World Health Organization - is to reduce opportunities for human exposure to the largest reservoir of the virus, viz, infected poultry. This is achieved through the rapid detection of poultry outbreaks and the emergency introduction of control measures, including the destruction of all infected or exposed poultry stock, and the proper disposal of carcasses.

Normally, avian influenza viruses do not infect humans because of host barriers to infection, such as cell receptor specificities. However, they can occasionally cross the species barrier and directly infect humans, including highly pathogenic strains that have caused a fatal disease in humans (Webby & Webster, 2003, p.1519). In 1997, avian influenza A (H5N1) caused an outbreak in domestic poultry in Hong Kong and also infected humans, hospitalizing 18 people and causing six deaths (Yuen, Chan & Peiris, 1998, p.467; Chan, 2004, p.58). Since then, other avian influenza outbreaks, e.g. H9N2 in 1999, H7N2 in 2002, and H7N7 in 2003, have resulted in human infections (Horimoto & Kawaoka, 2005, p.591).

To date no cases of bird flu caused by the H5N1 strain have been reported in South Africa. However, since the first isolation of an avian influenza virus, strain H5N2, two recent infections or presence of the H5N2 avian influenza-virus were detected in South Africa. Firstly, in August 2004, H5N2 avian influenza -virus was isolated on a farm in the Eastern Cape province and a second H5N2 outbreak during May 2006 in the Western Cape districts of Mossel Bay and Riversdale. According to the reports by the World Health
Organization, the World Organization for Animal Health and the South African Institute for Communicable Diseases, the H5N2-virus poses almost no risk to humans as humans do not have receptors for the virus in their respiratory tract. It is not similar to the H5N1 – virus affecting parts of Asia, with unfortunate associated human deaths (Pienaar & Horner, 2005, p.8).

According to the World Health Organization (2006c) the early containment of an emerging pandemic avian influenza virus represents an opportunity to stop or delay an event of predictably severe consequences for human health and the global economy, and this opportunity must be seized. At present, two primary strategies have been implemented for addressing the current avian influenza situation in an attempt to reduce a pandemic threat.

The first strategy, which aims to reduce opportunities for a pandemic virus to emerge, consists of efforts to contain outbreaks of highly pathogenic H5N1 avian influenza in poultry, prevent the spread of the disease to new countries, and thus reduce opportunities for human infections to occur. The prevention of high-risk behaviours is part of this strategy, as is the strengthening of an early warning system (World Health Organization, 2006e).

The second strategy, which is being introduced in tandem with the above strategy, is to intensify the world’s preparedness to cope with a pandemic, both nationally and internationally. Activities taking place within this strategy include the formulation of national preparedness plans, improved access to antiviral drugs, the development of pandemic vaccines and of plans for increasing their accessibility and affordability, planning for implementation of public health measures to reduce morbidity and mortality, and the development of communication plans and messages to improve compliance with recommended measures and reduce social and economic disruption (World Health Organization, 2006e).
The control of avian influenza in South Africa is taking place via its health system which is based on the primary health care philosophy for health care service delivery. As advocated by the World Health Organization a single comprehensive, equitable and integrated national health system (NHS) was established in South Africa, which is based on national guidelines, priorities and standards. The organisational structure of the NHS is discussed in a publication by the National Department of Health namely A National Health Plan for South Africa (African National Congress, 1994). Since 1995, various documents have been produced to provide guidance and to assist in the implementation of the new health system in South Africa (Maarschalk, 2003). Documentation includes relevant legislation, articles in journals, newspapers, and other publications (such as the South African Health Review and Internet sources).

From Section 1 of the National Health Act, 2004 (Act 61 of 2003), it can be deduced that the surveillance and prevention of communicable diseases is a function of environmental health practitioners at the municipal sphere of government. Responsibilities of Endemic Outbreak Response Teams at the different spheres of government in the event of a communicable disease outbreak are described from a national and provincial perspective in a document entitled Guidelines for outbreak response and epidemic management (National Department of Health, 2000). In order to assist countries in their national preparedness plans, the World Health Organization prepared a generic outline document entitled Preparing Influenza Pandemic Preparedness Plans: A Step – by Step Approach (World Health Organization, 2005c).

The surveillance and a summary of reporting requirements of avian influenza can be found in a document entitled World Health Organization guidelines for global surveillance of influenza A/H5 (World Health Organization, 2005b). The aim of this document is to monitor the spread of influenza A/H5 viruses in human and animal populations in order to assess the global trend of the

The epidemiology of avian influenza is described in a document entitled Avian Influenza which deals with comprehensive information on pathogenesis, microbiology, epidemiology, diagnosis, new cases around the world, possible treatment strategies and numerous other information on avian influenza (Center for Infectious Disease Research and Policy, 2006).

According to Doty (1989, p.86), work methods should be developed so that a task can be performed in the shortest possible time, with the greatest possible ease and with the most possible satisfaction to the operator. The revision and analysis of work methods and procedures are discussed in a book entitled Public administration and management: A guide to central, regional and municipal administration and management (Botes, Brynard, Fourie, & Roux, 1996). The need for formal work procedures is sufficiently illustrated in a publication by Cloete (1993), namely Administration and management of health services. The development of work procedures and the factors that inhibit the revision thereof is discussed in Public Administration and Management (Cloete, 1996). Furthermore, a study of work procedure and methods for medical practitioners is discussed by Andrews (1990) in Medical practitioners and nursing professionals as public managers.

The development of work methods and procedures for environmental health practitioners is discussed by Maarschalk (2003) in A conceptual framework for the development of a South African environmental health information system for decision – making. Procedures for public health officials for the control of avian influenza can be found in a document entitled Avian influenza, including Influenza A (H5N1), in Humans: World Health Organization Interim Infection
1.2. Problem statement
The National Department of Health has developed avian influenza guidelines (Influenza Pandemic Preparedness Plan of January 2006) to be used by the Provincial Health Departments and municipalities to develop their individual surveillance and control strategies. To date, none of the provinces and municipalities has developed detailed environmental health work methods and procedures within their areas of jurisdiction. This study will attempt to develop the said work methods and procedures to be used by environmental health practitioners within the municipal sphere of government in the Eastern Cape province - South Africa.

1.2.1. Sub problems
In order to effectively address the above, three sub problems have been identified. These are explained below.

1.2.1.1. The organisational arrangements for avian influenza surveillance and control in South Africa.
In terms of Section 1 of the National Health Act, 2004 (Act 61 of 2003), avian influenza surveillance and control can be regarded as a function of environmental health practitioners in the municipal sphere of government. Since there are a number of role-players in the national, provincial and municipal spheres whose decisions may influence the efficiency and / or effectiveness of avian influenza surveillance and control, it becomes necessary to critically analyse the organisational arrangements for avian influenza surveillance and control in South Africa. This analysis will enable the identification of inadequacies / weaknesses and the making of appropriate recommendations.
1.2.1.2. The epidemiology of avian influenza

The surveillance and control of a disease is dependent on its epidemiology. It is therefore important, when attempts are made to develop or improve existing work methods and - procedures, to have a thorough knowledge of the epidemiology of the disease. A thorough literature study on avian influenza as a disease was therefore necessary.

1.2.1.3. Work methods and - procedures for the surveillance and control of avian influenza.

As mentioned above, the National Department of Health has developed national avian Influenza surveillance and control guidelines. These guidelines are based on the World Health Organization’s template which must be customized by member countries. Neither the World Health Organization’s guidelines, nor that of the National Department of Health provides detailed work methods and - procedures on how to conduct the surveys. They also do not provide details on functional / practical control strategies or activities to be performed at the national, provincial and municipal spheres of government once an outbreak of avian influenza occurs. The implication of this situation is that each province and municipality will develop their own work methods and - procedures on how to conduct the surveys and control strategies. As a result, it would be impossible to consolidate relevant data within any of the three spheres of government because the data would not be valid (Cloete, 1993).

From the above it can be concluded that the work methods and - procedures for avian influenza surveillance and control must be exactly the same within each of the nine provinces for valid decisions to be made. With this study an attempt will be made to develop a standardised set of environmental health work methods and - procedures for the surveillance and control of avian influenza in the Eastern Cape province – South Africa. Other provinces should be able to use the results of this study during the development of their work methods and - procedures for the surveillance and control of avian influenza within their provinces and municipalities.
1.3. Purpose of the study

The general purpose of this study is to develop a standardised set of environmental health work methods and - procedures, which will contribute to effective avian influenza surveillance and control. More specifically the purpose of this study is to:

- Firstly, analyse the national health care system with specific reference to the place and role of environmental health practitioners at national, provincial and municipal spheres – in relation to avian influenza surveillance and control - with the purpose to identify inadequacies and to make appropriate recommendations;
- Secondly, analyse and describe the epidemiology of avian influenza, with focus on the distribution and characteristics of the disease in South Africa as a prerequisite for the development of formal work methods and - procedures for the surveillance and control of the disease; and
- Thirdly, to analyse relevant research that have been done globally and to use it, against the background of the above, to scientifically develop work methods and - procedures to be used by environmental health practitioners during the surveillance and control of avian influenza in the Eastern Cape province – South Africa.

In the next section the significance of the study will be addressed.

1.4. The significance of the study

The development of formal work methods and - procedures for avian influenza surveillance and control by environmental health practitioners is important because it gives legality and legitimacy to the actions of environmental health practitioners. The particular work methods and - procedures to be developed will compel environmental health practitioners to unite their efforts and work in an organised manner. It should also ensure that everyone co-operates in attaining set objectives (Maarschalk, 2003, p.10). The formal work methods and - procedures to be developed will make the actions of environmental health practitioners lawful and legal. It will also eliminate confusion amongst
future avian influenza surveillance and control personnel and make the actions of environmental health practitioners more purposeful and facilitate goal directed training (Maarschalk, 2003; Botes, et al., 1996; Cloete, 1996). Formal work methods and - procedures will enable the different spheres of government to integrate their data and to make information available from a local municipal, health sub-district, health district, provincial and national perspective.

From the above it can be deduced that it is important for every country to have effective avian influenza surveillance and control strategies in place. The results of this study will contribute to a comprehensive knowledge of avian influenza surveillance and control from an Eastern Cape provincial perspective.

1.5. Theoretical framework

According to Henning, Rensburg and Smit, (2004, p.7), research cannot be conducted in a theoretical vacuum, even though it may be exploratory. Social scientists achieve their position by virtue of their knowledge of what the field has to offer in terms of its theory – including its methodological theory. When a researcher sets out to investigate an issue he does so from a position of knowledge, and this knowledge can frame his inquiry.

Knowledge is constructed not only by observable phenomena, but also by descriptions of people’s intentions, beliefs, values and reasons, meaning making and self – understanding. Interpretive knowledge is dispersed and distributed. The researcher has to look at different places and at different things in order to understand phenomenon. That is why interpretivist research is a communal process, informed by participating practitioners and scrutinised and /or endorsed by others. Phenomena and events are understood through mental processes of interpretation, which are influenced by and interact with social contexts. The type of knowledge frameworks that drive society, also known as its discourse, become key role players in the interpretive project.
These “knowledge systems” are interrogated by the interpretive researcher who analyses texts to look for the way in which people make meaning in their lives. Thus, the interpretive researcher looks for the frames that shape the meaning. It thus holds that researchers in this paradigm are extremely sensitive to the role of context (Henning, et al., 2004, p.20).

This research is situated within an interpretivist research paradigm with its emphasis on experience and interpretation. Interpretive research is fundamentally concerned with the meaning and it seeks to understand a social member’s definitions and understanding of situations. It seeks to produce descriptive analysis that emphasises a deep, interpretive understanding of social phenomena (Henning, et al., 2004, p.12). This ties in with the focus of the proposed research, as its purpose is to gain a deep level of understanding of the perceptions of a specific group of environmental health managers, environmental health practitioners and other role players in the multisectoral communicable disease outbreak response teams in South Africa. More specifically, the research focuses on the understanding of individual participant’s experience and perceptions of their professional roles as experienced in their day to day working environment, from the standpoint of their unique contexts and backgrounds.

The foundational assumption of interpretivists is that most of our knowledge is gained, or at least filtered, through social constructions such as language, consciousness, shared meanings, documents and other artefacts. Interpretive research attempts to understand phenomena through the meanings that people assign to them (Trauth, 2001, p.219). The verbs “understand” and “construct” assume an interpretivist/constructivist theoretical paradigm (Henning, 2004, p.19). This description ties in with the intentions of the researcher to make inferences based on the data that will precipitate from the study and to construct goal orientated work methods and - procedures for the surveillance and control of avian influenza in the Eastern Cape province.
In the next section the research methodology and design of the study will be addressed.

1.6. **Research methodology and design**
Research methodology refers to the overall approach to the research process, from the theoretical underpinning to the collection and analysis of data (Collis & Hussey, 2003, p.55). A research method consists of the systematic, methodological and accurate execution of the research design (Babbie & Mouton, 2002, p.74).

According to Punch (2000, p.52), research design is the basic plan for research that shows how the research question will be connected to the data, and what tools and procedures will be used in answering them. In the following sections the research method and research design for this study are outlined.

1.6.1. **Research methodology**
In actualizing the proposed study the researcher will make use of qualitative research methods. Qualitative research is typically used to answer questions about the complex nature of phenomena, often with the purpose of describing and understanding the phenomena from the participant’s point of view (Leedy & Ormrod, 2005, p.94). A qualitative researcher seeks to establish the meaning of the phenomenon from the views of participants. The qualitative researcher collects data on an instrument or gathers information on a behavioral checklist (Creswell, 2003, p.17). Creswell (2003, p.182) argued that qualitative research is fundamentally interpretive. This means that the researcher makes interpretations of the data and then draws conclusions about its meaning, personally and theoretically.

Leedy and Ormrod (2005, pp.134 – 135) state that qualitative research comprises the following characteristics, namely description, interpretation, verification and evaluation. In order to conduct and complete this study, the
researcher will describe and explain the nature of avian influenza (study and analyse relevant information from documents and interviews) and finally draw conclusions in a strategy to develop work methods and procedures for avian influenza surveillance and control by environmental health practitioners in the Eastern Cape province. The researcher will, on completion of the study, send a copy to the participants for verification and evaluation until saturation occurs. This study will thus be based on a qualitative research approach.

1.6.2. Research design
Within the context of the purpose of this study, which is to develop environmental health work methods and procedures for the surveillance and control of avian influenza in the Eastern Cape province, an explorative, descriptive, inductive and deductive research design will be used. In the following sections these designs are briefly discussed.

1.6.2.1. Exploratory research
Exploratory research is done when few or no earlier studies were done which may serve as a source of verification of data (Collis & Hussey 2003, p.11). According to Silverman (2000, p.9), exploratory research is used to make preliminary investigations into relatively unknown areas of research. The topic of this research is relatively new and there is a lack of previous research, thus it conforms to the characteristics of an exploratory study.

1.6.2.2. Descriptive research
Descriptive research is research that describes phenomena, as they exist. It is used to identify and obtain information on the characteristics of a particular problem or issue (Collis & Hussey, 2003, p.11). The aim of descriptive research is attempting to describe a subject, often by creating a profile of a group of problems, people or events (Blumberg, Cooper & Schindler, 2005, p.10). Descriptive research can be qualitative or quantitative in nature. In qualitative research, according to Rubin and Babbie (2001, p.1125),
descriptive research refers to a more intensive examination of phenomena and their deeper meanings.

In this study, the researcher will describe the current strategy for avian influenza surveillance and control in the Eastern Cape province, including a description of the organisational structure of the national health system and the epidemiology of avian influenza. The work methods and procedures in relation to avian influenza surveillance and control that will be developed will also be described. This study will therefore also comply with the characteristics of descriptive research.

1.6.2.3. Inductive research

Scientific research can be divided into two categories, namely inductive and deductive. Inductive research reflects a reasoning process in which a theory is developed from observation of empirical reality. In addition, the empirical observations can be based on personal experience (Lancaster, 2005, p.25). According to Collis and Hussey (2003, p.15), inductive research involves moving from individual observation statements to general patterns or laws. It is also referred to as moving from the specific to the general.

Lancaster (2005, pp.25 -26) argued that inductive research is better suited for qualitative data. Inductive research and investigations begin from a description or observation and then move towards explanation. In this study, relevant conditions / situations within the Nelson Mandela Metropolitan Municipality (the only Category A municipality in the Eastern Cape province) and two of the six District (Category C) Municipalities will be analysed as specific cases in an attempt to explain the general conditions of other municipalities in the Eastern Cape province. For example, the organisational structure of the Nelson Mandela Metropolitan Municipality and two of the six District (Category C) Municipalities will be described as a model of the organisational structure in the municipal sphere of government regarding the surveillance and control of avian influenza. Furthermore, the researcher will
draw conclusions on the problems investigated from the qualitative data collected. An inductive research approach is thus appropriate for this study.

1.6.2.4. Deductive research
According to Lancaster (2005, p.22), deductive research develops theories or hypotheses and then tests the theories or hypotheses through empirical observation. For this reason, the deductive research method is referred to as moving from the general to a particular (Collis & Hussey, 2003, p.25). During this study, general theories and measures for communicable diseases prevention will be used to develop work methods and procedures for the surveillance and control of avian influenza. The deductive research method is therefore also applicable to this study. In the following section, the study population will be highlighted.

1.6.3. Study population
According to Polit and Hungler (1993, p.173) a research population is the entire aggregation of cases that meets a designated set of criteria. The research population for this study will comprise the two groups as explained below. The reasons for the selection of the two groups are given under the section dealing with sampling (see section 1.6.4).

- Group 1: The nine Provincial Communicable Disease Outbreak Control Co-ordinators (a group of experts); and
- Group 2: Managerial and line function personnel from two of the six District (Category C) Municipalities and the only Metropolitan (Category A) Municipality in the Eastern Cape province.

1.6.4. Sampling
Cormack (2002, p.263) refers to a sample as a group of people that a researcher selects about whom information will be collected. According to Paton (1990) in Holloway and Wheeler (2002, p.122), the sampling strategies
of the qualitative researcher are guided by the underlying principles of gaining rich, in depth information.

The purposive sampling technique will be utilised in this study. According to Parahoo (1997, p.232) this method of sampling involves the researcher deliberately choosing participants to include in the study on the basis that those selected can provide the necessary information. Holloway and Wheeler (2002, p.122) state that selection of participants is criterion based, that is that certain criteria are applied and a sample is chosen accordingly. The selection criteria of the two groups (also referred to as the sample groups) are discussed below:

**Group 1**

*The Provincial Communicable Disease Outbreak Control Co-ordinators of the nine provinces in South Africa (group of experts):*

These members are selected on the basis of their strategic positioning and roles that they fulfill. In order to respond appropriately to disease outbreaks, a Provincial Communicable Disease Outbreak Response Co-ordinator has been appointed for each of the nine provinces (National Department of Health, 2000). Their role includes the co-ordination of all activities, the organisation of team members as well as the co-ordination of communication to the local, national, and international media. Group 1 will take part in the study as a group of experts as discussed in sections 1.6.5.2 and 1.6.5.3.

**Group 2**

*Managerial and line function personnel from two of the six District (Category C) Municipalities and the only Metropolitan (Category A) Municipality in the Eastern Cape province:*

In order to obtain additional information (information such as the organisational structure of the health care system, the current status of Local Outbreak Response Teams, functional and managerial problems, semi-structured personal interviews with relevant role-players in the municipal
sphere of government will be conducted, namely with managerial and line function personnel from two of the six District (Category C) Municipalities and managerial and line function personnel from the Nelson Mandela Metropolitan (Category A) Municipality in the Eastern Cape province. With the semi-structured interviews the researcher will have a set of predetermined open-ended questions on an interview schedule (De Vos, Strydom, Fouché & Delport, 2002, p. 302).

1.6.5. **Data collection**

Qualitative research uses multiple methods that are interactive and humanistic (Creswell, 2003, p.181). The actual methods of data collection for this study will be based on the traditional qualitative research methods, namely documentary research and interviews. The following paragraphs describe these methods.

1.6.5.1. **Documentary research**

Documentary research is a basic method for qualitative data collection (Creswell, 2003, p.188). Documentary studies refer to documents that are being studied and analysed for the purpose of scientific research (De Vos, et al., 2002, p.322). For some research projects, the focus of data collection can be fully on documentary research (Blaxter, Hughes & Tight, 2001, p.167). McCulloch (2005, p.4) argued that social scientists had largely neglected and ignored the use of documentary research in recent years.

When documentary sources are studied, it is of cardinal importance that the researcher evaluates the documents by the criterion of usefulness, namely authenticity, credibility, representativeness and meaning (Denscombe, 2003, p.220; May, 2001, p.190). To conduct documentary research, the researcher can collect data from the following sources: government legislation, government publications, official statistics, other national and international publications (Daly, Kellehear & Gliksman, 1997, pp. 132 – 134).
1.6.5.2. **Group of experts**

According to Marshall and Rossman (1999, p.113) an elite interview (semi-structure interview) is a specialized type of interview. "Elite" individuals are those considered to be influential, prominent, and/or well informed people in an organization or community; they are selected for interviews on the basis of their expertise in areas relevant to the research.

According to De Vos, et al., (2002, p.311) a group of experts have a high level of knowledge in a particular field. This "expert panel" is often used in forecasting the future and other concepts that require the involvement of knowledgeable individuals (Rezabek, 2000, p.1).

In general, a group of experts are usually used in one of three ways. Morgan (1997, p.2), states that:

- Firstly, they are used as a self contained method in studies in which they serve as the principal source of data;
- Secondly, they are used as a supplementary source of data in studies that rely on some other primary method such as a survey; and
- Thirdly, they are used in multimethod studies that combine two or more means of data gathering in which no one primary method determines the use of the others.

The information gathered from the group of experts in this study forms part of a multimethod data gathering strategy. In this way, the group of experts will not stand alone, but contribute substantially to the methods of documentary research and in depth personal interviews that will be used in the study. The researcher will use questions on a telephonic interview schedule to obtain the relevant information from the participants in the group of experts that comprises of the Provincial Communicable Disease Outbreak Control Coordinators of the nine provinces in South Africa. The motivation for using a telephonic questionnaire is discussed in the next section.
1.6.5.3. **Telephonic questionnaire**

The New Dictionary of Social Work (1995, p.51) defines a telephonic questionnaire as a set of questions on a form which is completed by the respondent in respect of a research project. The telephonic questionnaire can be open ended or closed ended (De Vos, et al., 2002, p.172). Marshall and Rossman (1999, p.24) contends that the questionnaire must first be scrutinised for bias, sequence, clarity, and face validity. Questionnaires are usually tested through the administration to small groups to determine their usefulness and reliability. The researcher will first test the usefulness of the telephonic questionnaire in a pilot study by sending the questionnaire to two Environmental Health Practitioners in the Nelson Mandela Metropolitan Municipality for scrutiny before using it in the expert group.

The purpose for using a telephonic questionnaire for participants in the group of experts is to draw on their knowledge and experience of communicable disease surveillance and control in relation to avian influenza as well as their views on the role of the Environmental Health Practitioners in the Communicable Disease Outbreak Response Teams in the three spheres of government. Letters will be written to the employers of the nine provincial outbreak coordinators to ask permission to conduct telephonic interviews with the participants (see Annexure One). After confirmation, the researcher will phone the participants to arrange with them an appropriate time to conduct the telephonic interviews. The questions on the telephonic questionnaire are listed in Annexure Two. In Annexure Three the analysis of the data obtained during the telephonic interviews are presented.

1.6.5.4. **Personal interviews with managerial and line function personnel from two of the six district (Category C) municipalities and the only metropolitan (Category A) municipality in the Eastern Cape province**

Interviews are reflective and powerful ways of accessing people's perceptions, meanings, definitions of situations and constructions of reality (Punch, 2005, p. 168). The interview is one of the main data collection methods in qualitative
research. In qualitative research, the inquirer seeks to examine an issue related to opinions of individuals whom are interviewed to determine how they have personally experienced phenomena (Creswell, 2003, p.21). Interviews can be classified into three types, namely structured, semi-structured (focused) and unstructured (May, 2001, pp.121-126).

The semi-structured interview is designed to be focused in terms of topics and yet is flexible in that it is possible to steer questions into areas that appear promising from the point of view of providing rich data and additional insight (Lancaster, 2005, p.134). The researcher uses semi-structured interviews to gain detailed information of a participant's beliefs about a particular topic. This interview technique gives the researcher and the participant much more flexibility (De Vos, et al., 2002. p.302).

With semi-structured interviews the researcher will have a set of predetermined and open-ended questions on an interview schedule (De Vos, et al., 2002, p.302). According to (Holloway and Wheeler, 2002, p.81) unstructured interviews start with a general question in the broad study area.

In order to obtain additional information (information such as the organisational structure of the health care system in the Eastern Cape province, the current status of Avian Influenza Outbreak Response Teams, functional and managerial problems), semi-structured personal interviews with relevant role-players in the municipal sphere of government will be conducted, namely with managerial and line function personnel from two of the six District (Category C) Municipalities (Ukhahlamba District Municipality and Cacadu District Municipality) and managerial and line function personnel from the Nelson Mandela Metropolitan (Category A) Municipality in the Eastern Cape province. With semi-structured interviews the researcher will have a set of predetermined open-ended questions on an interview schedule (De Vos, et al., 2002, p. 302). The questions on the personal interview schedule can be found in Annexure Four. Not every question needs to be asked and a
participant can choose which question he/she wishes to answer at a specific time. A participant is thus allowed a key role in determining how the interview proceeds (De Vos, et al., 2002, p.303).

The researcher will inform the participants that the interviews will be on site, at their respective offices. Permission will be asked from the participants to use a tape recorder to record the interviews prior to interviewing. This will enable the researcher to record the exact words of the interview, inclusive of questions so that he does not forget important answers and words and can have eye contact and pay attention to what participants say. Each recording will be dated and labelled. The researcher will make contextual and field notes during the interviews (Holloway & Wheeler, 2002, p.87). According to Polit and Hungler (1993, p.216) it is essential for the researcher to record observations while still in the process of collecting information since memory failures are bound to occur if there is too long a delay. These notes will complement the interviews.

1.6.6. Entry to workplaces of participants

Formal permission is important in any research and protects both the researchers and participants. Access is sought in various ways (Holloway & Wheeler, 2002, p.38). Researchers negotiate with “gatekeepers”, the people who have the power to grant or withhold access to the setting. Researchers should not only ask the person directly in charge but also others who hold the power to start and stop the research (Holloway & Wheeler, 2002, p.40).

According to Halloway and Wheeler (2002, p.40) all gatekeepers have the power and control of access, but those at the top of the hierarchy are most powerful and should be asked first because they can restrict access even if everybody else agrees. The gatekeepers in this study will include the Municipal Managers in the Nelson Mandela Metropolitan Municipality, Ukhahlamba District Municipality and Cacadu District Municipality. Letters will be written to the Municipal Managers to ask permission to conduct interviews
with managerial and line function personnel that are responsible for avian influenza surveillance and control (see Annexure Five).

1.6.7. **Data analysis**

Data analysis is referred to as the process of bringing order, structure and meaning to the mass of collected data (De Vos, et al., 2002, p.339). The researcher is the human instrument in a qualitative research design. The process of qualitative data analysis will be based on data reduction and interpretation (Creswell, 2003, pp.143-144). Qualitative data analysis will be conducted simultaneously with data collection, data interpretation and narrative report writing. Rossman and Rallis (2003, p.24) believe that qualitative data analysis is an ongoing process involving continual reflection about the data, asking analytical questions and writing memos throughout the study. Data analysis is therefore not separated from other activities in the process, such as data collection and writing of the results (Creswell, 2003, p.190).

Qualitative research produces a large volume of data in a variety of formats, such as fieldwork notes and observations, transcripts from interviews and documents. Miles and Huberman (1994, p.12) developed an interactive data analysis model, which comprises three main components, namely data reduction, data display and drawing and verifying conclusions. These three components are interwoven and concurrent throughout the data analysis process, which involves three main operations: coding, memoing and developing propositions (Punch, 2005, pp.197-199).

Creswell (1998, pp.142-165) believes that the process of qualitative data analysis and interpretation can be represented in analytical circles rather than using a fixed liner approach. The coding process and data analysis will be conducted according to the steps suggested by Tesch (1990) in Cresswell (2003, p.192) and can be summarized as follows:
Get a sense of the whole. Read all the transcripts carefully and make short notes;

Pick one document at a time, go through it and try to make meaning of its contents, write notes in the margin;

When this action has been completed for several documents, make a list of all the topics. Cluster similar ones together and list them into columns that can be arranged as major topics, unique topics and leftovers;

Take the list and go back to the data. Abbreviate the topics as codes and write the codes next to the appropriate segments of the text to see whether new categories and codes emerge;

Find the most descriptive wording for the topics and turn them into categories;

Reduce the total list of categories by grouping topics that relate to each other;

Lines could be drawn between categories to show interrelationships;

Make a final decision on the abbreviation for each category and arrange these categories alphabetically;

Assemble the data material belonging to each category in one place and perform a preliminary analysis; and

Re-code existing data if necessary.

These theoretical guidelines will be used as a general guideline for the analysis of the raw data from the study, which will be transcripts from recorded in-depth interviews of participants. Transcripts of raw data will be handed over to an independent coder together with a guide for data analysis procedure. A consensus meeting between the researcher and the independent coder will follow. The following section addresses the trustworthiness of the study.

### 1.7. Trustworthiness

Trustworthiness represents the measures built into the process of research by the researcher to ensure that the study is valid and the results are reliable. Lincoln and Guba (1985, p. 290) used the “trustworthiness model” to refer to
the criteria of high quality research. Lincoln and Guba’s model comprises four aspects that reflect the assumptions of qualitative research, namely credibility, transferability, dependability and confirmability. The trustworthiness of this study in terms of Lincoln and Guba’s model is discussed below.

1.7.1. Credibility

Credibility is the internal validity, in which the goal is to demonstrate that the inquiry was conducted in such a manner to ensure that the subject was accurately identified and described (De Vos, et al., 2002, p.351). According to Krefting (1991, pp.215-217), strategies to ensure credibility include the authority of the researcher, field experiences, interview techniques, member checking, peer examination, reflexivity and structural coherence.

In this study, data will be collected mainly from authoritative documents such as formal publications from the World Health Organization and governmental publications. The different interview techniques will enhance the credibility of the study. The supervisor, an expert in this field, will also monitor the credibility of the research.

1.7.2. Transferability

Transferability is the external validity and refers to the degree or extent to which the findings of research data can be transferred to other groups other than the original study (De Vos et al., 2002, p.352). According to De Vos (2002, p.352), the strategy of triangulating multiple sources of data can enhance a study’s transferability. This means that designing a research in which multiple cases, multiple informants or more than one data collecting method that are employed can strengthen the study’s usefulness for other settings. In this study, the strategy of triangulating multiple resources for data as discussed earlier (see sections 1.6.5.1, 1.6.5.2, 1.6.5.3 and 1.6.5.4) will be used to strengthen its transferability.
1.7.3. **Dependability**
Dependability is the alternative to reliability, and is the criterion for consistency. This refers to the researcher attempting to account for the changing conditions to the chosen research phenomenon and the changes in design (De Vos et al., 2003, p.352). Strategies to ensure dependability in this study will be a dense description of research methods and triangulation (Krefting, 1991, p.217).

1.7.4. **Confirmability**
Confirmability refers to the objectivity or neutrality of the research (De Vos et al., 2002, p.352; Lincoln & Guba, 1985, p.209). This means that no prejudice is evident in the research process and results. According to Krefting (1991, p.217), strategies to ensure confirmability include confirmability audit, triangulation and reflexivity. Both the research process and research results will be audited by the supervisor, independent coder and experts in this field to ensure the confirmability of the study.

1.8. **Ethical considerations**
According to Marshall and Rossman (1999, p.90), the qualities that make a successful researcher are revealed through the exquisite sensitivity to the ethical issues present when we engage in any moral act. Ethical considerations are generic – informed consent and protecting participant’s anonymity – as well as situation specific. Kvale (1996, pp.109-118) adds that respondents must be fully informed as to what is going to happen to the information after recording.

This study will not harm the environment, humans or animals because no experiments or trials are involved. Informed consent will be obtained from the participants prior to the start of the study (see Annexure Six). The participants, who are adult professionals, will be informed as to what will happen with the results throughout the study. Ethics approval from the Nelson Mandela
1.9. **Pilot study**

A pilot study is defined as the process whereby the research design for a prospective survey is tested. The pilot study can be regarded as a small scale trial run of all the aspects planned for use in the main inquiry (De Vos et al., 2002, p. 211). According to De Vos, et al., (220, pp. 211-215), a pilot study involves four aspects, namely literature study, interviews with experts, exploring the actual research area and intensive study of strategic units. A literature study will be conducted by the researcher and monitored by the supervisor to ensure that the findings and results of the study will meet the purpose of the study. Furthermore, the telephonic and personal interview schedules will be tested with a participant who is in the employment of the Nelson Mandela Metropolitan Municipality as to ensure that the right questions are being asked. Modifications to the telephonic and personal interview schedules will be made if necessary.

1.10. **Plan of the study**

The study is divided into six chapters, namely:

- Chapter 1: Introduction;
- Chapter 2: Avian influenza: The place and role of Environmental Health in the national, provincial and municipal spheres of government;
- Chapter 3: The epidemiology of avian influenza;
- Chapter 4: Work methods and - procedures for the surveillance of avian Influenza;
- Chapter 5: Work methods and - procedures for the control of avian Influenza; and
- Chapter 6: Conclusion and recommendations.

In **Chapter One** a thorough literature review of the study is presented. The problem and sub-problem statements of the study are also presented in this
chapter. This is followed by an explanation of the purpose, significance and theoretical framework of the study. Furthermore, the research design and methodology to be adopted for the study are explained and motivated. Also identified and discussed are the measures for trustworthiness and ethical considerations.

In **Chapter Two** an attempt is made to define Environmental Health, to identify the functional areas of the environmental health profession and to identify the professional regulatory framework and requirements of the profession. Furthermore, the national health care system in South Africa is analysed with specific reference to the place and role of environmental health, as well as that of other role players within the health care system whose decisions may have an influence on the effectiveness of environmental health service delivery. The said organisational structure is discussed from a national, provincial and municipal perspective. Regulatory documentation relevant to avian influenza surveillance and control are also introduced and discussed.

**Chapter Three** provides a comprehensive discussion of the influenza virus, with specific references to the epidemiology of the virus and the mechanisms of variability. Also explained are the difference between human seasonal influenza, avian influenza and human pandemic influenza. The different sources and transmission methods of avian influenza in birds and humans are identified and discussed. Furthermore described are the incidences of the avian influenza in South Africa and in the rest of the world. Lastly addressed in Chapter Three is the risk of an avian influenza pandemic.

**Chapter Four** deals with work methods and procedures for avian influenza surveillance. The basic principles of avian influenza surveillance are explained from a public health surveillance perspective. In this chapter work methods and procedures for human case surveillance are discussed from four perspectives, namely case detection, notifiable disease reporting, the
investigation of an avian influenza outbreak and case confirmation. Also
discussed in this chapter are work methods and procedures for bird
surveillance from four perspectives, namely the early detection of avian
influenza amongst birds, clinical surveillance, serological surveillance and
virological surveillance.

**Chapter Five** focuses on work methods and procedures for the control of
avian influenza. In this chapter avian influenza control is discussed from four
perspectives, namely basic strategies for avian influenza control; control
strategies for avian influenza in humans; control strategies for avian influenza
in birds and the role of Avian Influenza Endemic Outbreak Response Teams.
This chapter also focuses on the place and role of environmental health
practitioners in the national, provincial, district and sub-district communicable
disease outbreak response teams.

**Chapter Six** presents a conclusion with emphasis on the findings of the study.
Appropriate recommendations are also made.

1.11. Clarification of key concepts
According to Garbers (1996, p.290) the multiplicity of interpretations of
concepts in the human sciences necessitates that the main concepts be
clarified in research. In the following sections theoretical definitions and
explanations are given for the key concepts as used during this study.

1.11.1. Municipal health services
In terms of Section 1 of the *National Health Act*, 2004 (Act 61 of 2003),
municipal health services include the following:

- Water quality monitoring;
- Food control;
- Waste management;
- Health surveillance of premises;
• Surveillance and prevention of communicable diseases, excluding immunisations;
• Vector control;
• Environmental pollution control;
• Disposal of the dead;
• Chemical safety,

but excludes port health, malaria control and control of hazardous substances.

Avian influenza surveillance and control is an activity under the services: surveillance and prevention of communicable diseases (see bullet five above).

1.11.2. **Avian influenza**

Avian influenza, also called fowl plague, avian flu and bird flu, is a highly contagious viral disease with up to 100% mortality in domestic fowl. The disease is caused by the influenza A virus, subtypes H5 and H7. All types of birds are susceptible to the virus but outbreaks occur most often in chickens and turkeys. The infection may be brought by migratory wild birds, which can carry the virus without showing any signs of the disease. Type A influenza viruses can infect several animal species aside from birds, including pigs, horses, seals and whales. Birds are an especially important species because all known subtypes of influenza A viruses circulate among wild birds, which are the natural hosts for influenza A viruses (Center for Infectious Disease Research and Policy, 2006).

1.11.3. **A human avian influenza outbreak**

A disease outbreak is referred to as an epidemic that is limited to a localized increase in the incidents of a disease (World Health Organization, 1999, p. 150). According to Connolly (2005, p.107), a disease outbreak is defined as the occurrence of a number of cases that is unusually large or unexpected for a given place and time. In this study, a human avian influenza outbreak can be defined as a sudden occurrence of one or more confirmed human cases within a specific geographic area.
1.11.4 Avian influenza surveillance

The World Health Organization (1999) defines surveillance as the systematic ongoing collection, collation and analysis of data and the timely dissemination of public health information for assessment and action as necessary. Surveillance is also defined as the process of systematic collection, orderly consolidation and evaluation of pertinent data with prompt dissemination of the results to those who need to know, particularly those who are in a position to take action (Thacker, 1996, p.11). Avian influenza surveillance is therefore a continuous and systematic process of collection, analysis, interpretation, and dissemination of descriptive information of avian influenza monitoring activities.

1.11.5 Avian influenza control

Control of infectious diseases refers to the actions and programmes directed towards reducing disease incidence and prevalence (Kim-Farley, 1997, p.1561). Control of avian influenza can therefore be considered as the actions and programmes directed toward preventing and reducing avian influenza incidences and prevalence.

1.11.6 Work methods

A method is defined as the way in which each step of a procedure is to be performed (Liebler & McConnell, 1999). It is also defined as ‘a special form of procedure’ or ‘orderliness; regular habits’ (Thompson, 1995). Work methods in this study will be defined as the procedure of a sequence of actions by environmental health practitioners used to accomplish the task of avian influenza surveillance and control.

1.11.7 Work procedures

A procedure is a series of interrelated sequential steps established for the accomplishment of a task (Kanawaty, 1992). In this study, work procedures will be defined as a series of scientifically formulated and interdependent
consecutive steps which must be taken towards the achievement of avian influenza surveillance and control (Andrews, 1990; Maarshalk, 2003).

In the following chapter the national health care system in South Africa is analysed. The chapter attempts to identify the place and role of environmental health, as well as that of other role players within the health care system whose decisions may have an influence on the effectiveness of environmental health service delivery.
CHAPTER TWO
AVIAN INFLUENZA - THE PLACE AND ROLE OF ENVIRONMENTAL HEALTH
WITHIN THE ORGANISATIONAL STRUCTURE OF THE HEALTH CARE
DISPENSATION IN SOUTH AFRICA

2.1. Introduction
In order to develop effective work methods and procedures for a specific functional activity of a profession it firstly becomes necessary to have a clear understanding of the profession itself, as well as its place and role within the organisational structure within which it functions. It also becomes necessary to identify the place and role of relevant decision-makers whose decisions may have a direct or indirect influence on the execution of the said functional activity.

Firstly, due to the absence of an official definition of environmental health from a South African perspective, an attempt will be made to define the concept. This will be done by analysing work that has been done by relevant authors and organisations. Secondly, the fields of activity of the environmental health profession, as it applies internationally as well as in South Africa will be discussed. Thirdly, the place and role of environmental health, as well as that of other role players within the health care system whose decisions may have an influence on the effectiveness of environmental health service delivery, will be identified and discussed. In the next section the environmental health profession is introduced.

2.2. The Environmental Health profession
This discussion includes the definition of environmental health, the functional areas of the environmental health profession and the professional regulatory framework and requirements relevant to the profession.
2.2.1. **Environmental Health defined**

In order to have a meaningful discussion of the place and role of environmental health within the organisational structure of the health care system in South Africa, it firstly becomes necessary to define Environmental Health from a South African perspective. In the absence of a formal South African definition (Maarschalk, personal communication, August 2, 2007) an analysis of relevant work that has been done by a number of authors and organisations will be presented.

Throughout the years, various attempts have been made to define the concept Environmental Health. In analysing these definitions the deduction could be made that each definition was developed to represent the views and needs of the defining agency or organization. According to the National Institute of Environmental Health Sciences of the United States of America (2005), Environmental Health is a field of science that studies how the environment influences human health and disease. The environment, in this context, means things in the natural environment like air, water, soil and also all the physical, chemical, biological and social features of the surroundings. From this definition it can be concluded that the said Institute defines Environmental Health as a science that not only studies how the environment influences human health, but also how the environment influence disease. It can also be deduced that the environment (i.e. air, water and soil) has physical, chemical, biological and social features and that it is the influence that these features have on human health that the “science” environmental health is studying.

The World Health Organisation (2007a) states that environmental health comprises those aspects of human health, including quality of life, that are determined by the physical, chemical, biological, social, and psychosocial factors in the natural environment. It also refers to the theory and practice of assessing, correcting, controlling, and preventing those factors in the environment that can potentially affect adversely the health of present and
future generations. "Health" in this context is said to mean “… a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity”.

The Western Cape Department of Health (2007, p.1) defines environmental health in a similar way as the World Health Organisation by stating that environmental health can be regarded as the identification, evaluation, control and prevention through education of all those factors in the total environment which exercise a detrimental effect on an individual’s physical, mental and social well being and development. It also implies continuous efforts to educate and prevent individuals from affecting the environment in such a way that it becomes detrimental to their wellbeing and development.

According to Slabbert (2002, p.4), in its broadest sense, environmental health is a segment of public health that is concerned with assessing, understanding and controlling the impacts of people on their environment and the impact of the environment on them. Moeller (1992, p.23) defines environmental health as the art and science of protecting and promoting good health through the organised efforts of society and includes the promotion of the aesthetic, social, economic, cultural and amenity values; the fostering of positive environmental factors; and the reduction of potential hazards (physical, biological, chemical and social). Last (1998, p.107) agrees with Moeller by defining environmental health as the art and science of preventing disease, prolonging life and promoting health through the organised efforts of society. Pope, Snyder and Mood (1995, p.3) on the other hand, state that environmental health concerns the identification and control of all factors known at any time, to have a direct or indirect effect on health. These include the biological, chemical, physical and social factors in the environment.

From the definitions presented above it can be concluded that environmental health is about the protection and promotion of human health by the mitigation and prevention of those environmental factors that can have an adverse affect
on human health. The said factors are limited to the physical, chemical, biological and social factors in the environment. Furthermore, environmental health can be regarded as a facet of public health that involves the analysis (assessing, identification) of the said factors in the environment and the introduction of strategies (correcting, controlling and preventing) to rectify or prevent the occurrence of those factors that can potentially adversely affect the state of human well-being. In the next section the functional areas of the environmental health profession will be discussed.

2.2.2. The functional areas of environmental health service delivery

Basset (1992, p.xxi) is of the opinion that the essence of environmental health service delivery from an international perspective is the prevention, detection and control of environmental hazards that affect human health. This will include the following functional areas which constitute an integral part of that process:

- Waste management;
- food control;
- housing;
- epidemiological control;
- air quality management;
- occupational health and safety;
- water resource management;
- noise control;
- protection of the recreational environment;
- radiation health;
- control of frontiers, air and sea ports and border crossings;
- educational activities;
- * promotion and enforcement of environmental health quality standards;
- * collaborative efforts to study the effects of environmental hazards; and
- * environmental impact assessments.
According to Basset (1992, p.xxi) the last three functional areas (see * above) overlap with one another, and involve all twelve areas listed above them. The functional areas of the environmental health profession as practiced in South Africa can be deduced from Section 1 of the National Health Act, 2004 (Act 61 of 2003). In terms of this section “municipal health services” includes the following:

- Water quality monitoring;
- food control;
- waste management;
- health surveillance of premises;
- surveillance and prevention of communicable diseases, excluding immunisation;
- vector control;
- environmental pollution control;
- disposal of the dead;
- chemical safety,

but excludes port health, malaria control and the control of hazardous substances which are provided by the National and Provincial Health Departments. Avian influenza surveillance and control is an activity under the services: surveillance and prevention of communicable diseases (see bullet five above). In the next section the environmental health-decision makers at the national sphere of government will be identified and discussed.

The scope of the environmental health profession as practised in South Africa, in relation to the functional areas listed above, is defined in Regulation 888 promulgated in terms of Section 33(1) of the Medical, Dental and Supplementary Health Service Professions Act, 1974 (Act 56 of 1974), and subsequently amended by the Health Professions Act, 1974 (Act 56 of 1974). According to Sub-section 2(1) of this regulation the following acts shall be deemed to be acts pertaining to the profession of the environmental health practitioner:
(a) The identification of all unhygienic conditions and the evaluation of all factors of hygiene regarding the interaction between man and his environment.

(b) The undertaking of acts supplementary to statutory duties to:

(i) Eliminate unhygienic conditions;

(ii) execute monitoring actions in order to give effect to acts for the safeguarding and maintenance of the health of the population;

(iii) give health education in order to make the population self-sufficient in respect of the creation and maintenance of an environment that is safe for health.

(iv) co-operate with a multi-disciplinary team in accordance with the principles of interdependency for the establishment of an environment that is safe for health.

According to Section 2 of the above-mentioned regulation the acts of an environmental health practitioner shall pertain to:

(a) General or environmental hygiene which is applicable to the population and which consists mainly of the provision of dwellings that are safe for health, sewage, rubbish removal, the disposal of effluent and healthy hygienically handled foodstuffs and supervision over environmental health factors which may have a detrimental effect on the population;

(b) industrial hygiene, a branch of general hygiene, which concerns the provision of healthy working conditions in industries and the prevention of occupational diseases and accidents and which includes operational and factory hygiene.

In analysing the above-mentioned functional areas and the scope of the environmental health profession as practised in South Africa with Basset's international perspective, it can be concluded that all the functional areas, including the scope of the profession as practised in South Africa correlate with the international perspective. In the next section the professional
regulatory framework and requirements of the environmental health profession are discussed.

2.2.3. Professional regulatory framework and requirements

According to the Western Cape Department of Health (2007, p.1), Environmental Health Practitioners in South Africa are appointed in terms of the Health Act, 1977 (Act 63 of 1977). The environmental health practitioner has, in terms of this Act, been appointed and authorised to implement the Act and its regulations. In terms of Section 56 of the said Act, the environmental health practitioner has the authority to serve a health notice on any person, individual or company to deal with a health problem or situation that may be dangerous or injurious to human health. Legal action can be taken in terms of the act, should it be deemed necessary.

In order to practice as an environmental health practitioner in the Republic of South Africa a person needs to complete an undergraduate qualification in environmental health which is recognised by the Health Professions Council of South Africa. Presently this qualification is called the National Diploma: Environmental Health. The Baccalaureus Technologiae (B.Tech), Magister Technologiae (M.Tech), and Doctor Philosophiae (D.Tech) are recognized by the Health Professions Council of South Africa as additional qualifications of environmental health practitioners (Health Professions Council of South Africa, 2007)

The environmental health practitioner are not only qualified at graduate level but must also complete a period of compulsory practical training in practice. They are also required to be registered with the Health Professions Council of South Africa as Environmental Health Practitioners and are furthermore also required to develop skills through a Continued Professional Development Programme in order to maintain their level of professional competency. Since April 2004, the Professional Board for Environmental Health Practitioners in the Republic of South Africa has introduced a compulsory system of
Continued Professional Development which could be defined as the systematic maintenance, improvement and broadening of knowledge and skills and the development of personal qualities necessary for the execution of professional and technical duties throughout a practitioner’s working life. This programme is in line with the aims and objectives of the South African Institute of Environmental Health (South African Institute of Environmental Health, 2007) which are to:

- Advance and promote the science and practice of Environmental Health;
- affiliate and liase with local, national and international bodies aimed at promoting the science and practice of environmental – as well as public/community health;
- protect and promote the interests and status of all members registered with the Institute;
- promote strong unity amongst members irrespective of race, colour, sex, religion, creed, political aspiration and/or affiliation;
- promote the professionalism of its members;
- create structures that would promote and enable the involvement and participation in the affairs of the Institute by members at all levels; and
- promote the basic training as well as comprehensive specialised advanced education of environmental health professionals as well as environmental health research.

According to Mbhele (personal communication, August 28, 2007), a major part of the work of the environmental health practitioner involves the enforcement of legislation which includes the:

- **Atmospheric Pollution Prevention Act**, 1965 (Act 45 of 1965);
- **Foodstuffs, Cosmetics and Disinfectants Act**, 1972 (Act 54 of 1972);
- **Hazardous Substances Act**, 1973 (Act 15 of 1973);
- **Health Act**, 1977 (Act 63 of 1977);
- **Animal Diseases Act**, 1984 (Act 35 of 1984);
In the next section the place and role of environmental health within the organisational structure of the health care system in South Africa will be discussed.

2.3. The place and role of environmental health within the organisational structure of the health care system in South Africa

In order to develop detailed environmental work methods and procedures for the surveillance and control of avian influenza in the Eastern Cape province, it firstly becomes necessary to identify the place and role of the environmental decision-makers within the South African health care system. Government in the Republic of South Africa renders environmental health services through a health care dispensation that is divided into national, provincial and municipal spheres. Since there are a number of role players in the national, provincial and municipal spheres whose decisions may influence the efficiency and/or effectivity of avian influenza surveillance and control within the said spheres, it becomes necessary to critically analyse the organisational arrangements for avian influenza surveillance and control in South Africa. This analysis will enable the identification of inadequacies or weaknesses and the making of appropriate recommendations. In the next section attention will firstly be given to legislation relevant to health care service delivery in South Africa.
2.3.1. Legislation relevant to health care service delivery in South Africa

According to Rensburg (2004, p.118), legislation provides certainty to the institution in its policy and establishes structures and mechanisms to put policy into practice. It is therefore necessary to discuss the relevant legislation when attempts are made to analyse the organisational structure for avian influenza surveillance and control in South Africa. In the section below attention is given to the constitutional imperatives that are relevant to health care service delivery in South Africa.

2.3.1.1. Constitutional imperatives relevant to health care service delivery in South Africa

In this study the Constitution means the Constitution of the Republic of South Africa Act, 1996, (Act 108 of 1996). The Republic of South Africa consists of national, provincial and local spheres of government, which are distinctive, but also interdependent and interrelated. The Constitution confirms and entrenches the existence of these three levels of government and distinguishes between legislative, executive and juridical power. In Chapter Three of the Constitution, the relationship among the spheres of government is determined in accordance with the principle of co-operative governance.

According to Slabbert (2002, p.1), the Constitution is the supreme law of the country and represents a fundamental break from the past. Furthermore, there is an obligation on all three spheres of government to honour the rights of all people with regard to the delivery of health services. Rensburg (2004, p.137) agrees with Slabbert (2002, p.1) and states that the Constitution gives conspicuous expression to the fundamental right to health care for all; and also rules that the delivery of health care services is a concurrent function amongst the three spheres of government within a framework of co-operative governance. For the purpose of this study, the contents of the health rights are summarised below as described and reflected in Sections 24-28 of the Constitution. All South African citizens have a right to:
• An environment that is not harmful to their health and wellbeing;
• access to health care services;
• emergency medical treatment; and
• basic nutrition, shelter, basic health care services and social services.

From the above it can be concluded that the development of work methods and procedures for the surveillance and control of avian influenza can be regarded as an attempt to protect the constitutional rights of the people in South Africa.

According to the Section 27(2) of the Constitution, the State must take reasonable legislative and other measures within its available resources to achieve the progressive realisation of the rights of the people of South Africa to have access to health care services. According to Slabbert (2002, p.2) it was in the spirit of the Constitution that a new National Health Act was prepared which replaced the National Health Act, 1977 (Act 63 of 1977). In the section below the significance of the National Health Act, 2004 (Act 61 of 2003), for environmental health will be discussed.

### 2.3.1.2. The significance of the National Health Act, 2004 (Act 61 of 2003) for environmental health

The National Health Act, 2004 (Act 61 of 2003), provides the framework for a structured and uniform national health care system within the Republic of South Africa. The said act takes into account the obligations imposed by the Constitution and other laws of the national, provincial and local governments with regard to health services and to provide for matters connected therewith. The national health system means the system within the republic, whether within the public or private sector, in which the individual components are concerned with the financing, provision or delivery of health services (Limpopo Provincial Health Department, 2004).
The promulgation of the National Health Act, 2004 (Act 61 of 2003), provided the legislative foundation to:

- Unite the various elements of the national health system in a common goal to actively promote and improve the national health system in South Africa;
- provide for a system of co-operative governance and management of health services, within national guidelines, norms and standards, in which each province, municipality and health district must address questions of health policy and delivery of quality health care services;
- establish a health system based on decentralised management, principles of equity, efficiency, sound governance, internationally recognised standards of research and a spirit of inquiry and advocacy which encourages participation;
- promote a spirit of co-operation and shared responsibility among public and private health professionals and providers and other relevant sectors within the context of national, provincial and district health plans.

The promulgation of the National Health Act, 2004 in 2003, provided direction and clarity on the definition of municipal health services. According to Agenbag (personal communication, April 2, 2007), municipal health services are environmental health services. This statement is in line with a MINMEC (Minister of Health and relevant Members of the Provincial Executive Councils of the nine provinces) decision dated 21 August 2003 when it was decided, with the concurrence of the Minister for Provincial and Local Government, that municipal health service delivery will be the responsibility of metropolitan (metro's) and district municipalities (not local municipalities) and to define municipal health services as “environmental health services”. This decision was effective from 1 July 2004. The MINMEC decision was arrived at after a period of extensive consultation with key stakeholders which includes amongst others, the relevant Members of the Executive Councils (MEC’s) of the nine provinces, the National Treasury, Financial and Fiscal Commission of
South Africa (FFC), South African Local Government Association (SALGA) and the Municipal Demarcation Board (Agenbag, 2006).

From the above it can therefore be concluded that health services in the municipal sphere of government must be interpreted as environmental health services. In terms of Section 1 of the National Health Act, 2004 (Act 61 of 2003), these services include the services as listed in section 2.2.2 on page 37. In the next section legislation relevant to avian influenza will be discussed.

2.3.1.3. Other legislation relevant to avian influenza health care service delivery in South Africa

The spread of avian and human influenza does not respect national boundaries and there could be simultaneous outbreaks in different parts of the world. Co-ordination of preparedness and response at the international, regional, and national level is therefore essential (Nagpal, personal communication, December 5, 2007).

During May 2005 the World Health Organization in Geneva replaced the International Health Regulations, 1969 with the International Health Regulations, 2005 in an effort to manage public health emergencies of international concern. These regulations are an international legal instrument which is binding on all World Health Organization member states and all non-member states of the World Health Organization that have agreed to be bound by it. The general objectives of the International Health Regulations, 2005 are to:

- Prevent;
- protect against;
- control; and
- provide a public health response to the international spread of disease.
Many of the provisions in the new regulations are based on the experience gained and lessons learnt by the World Health Organization and the global community over the past 30 years. The need for new rules and operational mechanisms for a more co-ordinated international response to the spread of disease has been most clearly shown during the outbreaks of Severe Acute Respiratory Syndrome (SARS) in 2003 and avian influenza in 2004-2005. The regulations govern the roles of countries and the World Health Organization in identifying and responding to public health emergencies and the sharing of information.

The original International Health Regulations, 1969 were designed to help monitor and control four serious infectious diseases - cholera, plague, yellow fever and smallpox. The new regulations, International Health Regulations, 2005 govern a broader range of public health emergencies of international concern, including emerging diseases such as avian influenza. The new International Health Regulations, 2005, greatly expand the World Health Organization’s and member states obligations to take concrete, often daily actions to prevent, protect against, control and provide a public health response to the international spread of the said diseases. The fundamental principle of the International Health Regulations, 2005 is to ensure maximum security against the international spread of diseases with a minimum interference with world traffic (World Health Organization, 2005d).

According to Pienaar and Horner (2006, p. 26), the presence of avian influenza viruses in wild birds creates a particular problem and makes it problematic to provide specific guidelines for the surveillance and control of the disease in wild birds. In essence, no country can declare itself free from avian influenza in wild birds. In the Republic of South Africa, the Animal Diseases Act, 1984 (Act 35 of 1984) states that poultry means pigeons, ducks, geese, fowl, turkeys, cage birds, muscovies, domesticated ostriches, tamed wild birds and wild birds kept in captivity. South Africa is currently free from Highly Pathogenic Notifiable Avian Influenza (HPNAI) and two Acts play an important role in maintaining this freedom, namely the Animal Diseases Act, 1984 (Act 35 of 1984) and the Meat Safety Act, 2000 (Act 40 of 2000) (Pienaar & Horner, 2006, p.26). The specific measures that are in place to safeguard the country against the introduction of this virus into the country will be discussed in the following two chapters that deal with work methods and work - procedures for the surveillance and control of avian influenza.

According to Pienaar (personal communication, January 14, 2007) the Animal Diseases Act, 1984 (Act 35 of 1984), will be amended to make all subtypes of avian influenza notifiable diseases. This would mean that any outbreak or suspicion of an outbreak has to be reported to the World Health Organization. Until the amended regulations have been published, control measures with regards to Low Pathogenic Avian Influenza involve voluntary isolation and voluntary movement control. In the next section the organisational structure of the National Department of Health will be discussed.

2.3.2. The organisational structure of the National Department of Health
Within the national sphere of government a number of decision-makers can be identified whose decisions may have either a direct or indirect influence on environmental health service delivery throughout South Africa. The following section identifies and discusses these decision-makers. The Minister of Health is firstly introduced.
2.3.2.1. **The Minister of Health and the Cabinet**

Section 3 of the *National Health Act*, 2004 (Act 61 of 2003), states that the Minister of Health is the Cabinet member responsible for health. The said Minister is responsible within the limits of available resources to:

- Endeavour to protect, promote, improve and maintain the health of the population;
- promote the inclusion of health services in the socio-economic development plan of the Republic;
- determine the policies and measures necessary to protect, promote, improve and maintain the health and well-being of the population;
- ensure the provision of such essential health services, which must at least include primary health care services, to the population of the Republic as may be prescribed after consultation with the National Health Council; and
- equitably prioritise the health services that the State can provide.

The Minister of Health, in terms Section 92(2) of the *Constitution of the Republic of South Africa Act*, 1996 (Act 108 of 1996), is accountable to Parliament for the exercise of powers and the performance of functions related to health. In terms of Section 90(1) of the *National Health Act*, 2004 (Act 61 of 2003), the Minister, after consultation with the National Health Council, may promulgate regulations regarding communicable diseases and notifiable medical conditions.

From the above it can be deduced that the Minister of Health is responsible for the protection, promotion and maintenance of the health of the people of South Africa. It can also be deduced that proposed regulations pertaining to avian influenza surveillance and control must first be sanctioned by the Minister of Health before it can be promulgated into legislation. To assist the Minister in decision-making and to enable the Minister to report to Parliament, a National Health Council has been established which is discussed below.
2.3.2.2. The National Health Council

According to Section 22(2) of the National Health Act, 2004 (Act 61 of 2003), the National Health Council consists of the following:

- The Minister of Health, who acts as chairperson;
- the Deputy Minister of Health;
- the relevant members of the Executive Councils of the nine provinces;
- one municipal councillor, representing organised local government (the South African Local Government Association) and appointed by the national organisation contemplated in Section 163(a) of the Constitution, 1996 (Act 108 of 1996);
- the Director-General and the Deputy Directors-General of the National Department of Health;
- the Head of each Provincial Department;
- one person employed and appointed by the national organisation contemplated in Section 163(a) of the Constitution; and
- the Head of the South African Military Health Service.

The National Health Council must advise the relevant Minister on policy concerning any matter that will protect, promote, improve and maintain the health of the population. Some of the said matters include:

- Epidemiological surveillance and the monitoring of national and provincial trends with regard to major diseases and risk factors for disease; and
- the obtaining, processing and use of statistical returns; (Section 23 of the National Health Act, 2004 (Act 61 of 2003)).

According to Dennill, King, Lock and Swanepoel (1995, p.40), the National Health Council is responsible for the provision, development and co-ordination of all health care in South Africa. The National Health Council may create one or more committees to advise it on any health-related matters.
The deduction that can be made from the above is that the National Health Council is responsible for the provision, development and co-ordination of all health care in South Africa. A further deduction that can be made is that the National Health Council must advise the Minister of Health on information relating to the surveillance and control of avian influenza. To ensure that input from a broad perspective is obtained, the National Health Council is allowed to establish advisory committees. It can thus be concluded that the contribution of such committees may lead to more effective policy within the national sphere of government. In the next section the functions of the Director – General of Health will be discussed.

### 2.3.2.3. The Director-General of Health

The Director-General of the National Department of Health has the responsibility to supply health-related information to the Minister of Health. This information can either be supplied directly to the Minister of Health or through the National Health Council (Section 21 of the *National Health Act*, 2004 (Act 61 of 2003)).

According to Section 21 of the *National Health Act*, 2004 (Act 61 of 2003), the Director-General is annually responsible for the preparation of strategic, medium term health and human resources plans for the exercise of the powers and the performance of the duties of the National Department of Health. In addition to the above, the Director-General must also integrate the health plans of the national department and provincial departments once a year and submit the integrated health plans to the National Health Council. These health plans form the basis of the department’s budget as outlined in Section 215 of the *Constitution of the Republic of South Africa Act*, 1996 (Act 108 of 1996).

From the above it can be concluded that the Director-General of Health has the responsibility to supply factual health-related information to the Minister of Health. The Director-General is also responsible for the implementation of
national health policy in South Africa. It can therefore be concluded that the Director-General plays a key role in the promotion and implementation of policies regarding avian influenza surveillance and control throughout South Africa. The Director-General cannot perform the above-mentioned functions unilaterally. He/she therefore relies on the Deputy Director-Generals of the National Department of Health and the National Consultative Health Forum to supply him/her with sufficient information to make informed decisions. In the following section the National Consultative Health Forum will be discussed.

2.3.2.4. National Consultative Health Forum

According to Section 24 of the National Health Act, 2004 (Act 61 of 2003), it is the responsibility of the Minister of Health to establish a body to be known as the National Consultative Health Forum. The National Consultative Health Forum must promote and facilitate interaction, communication and the sharing of information on national health issues between representatives of the national department, national organisations identified by the Minister and provincial consultative bodies contemplated in Section 28 of National Health Act, 2004 (Act 61 of 2003). The Minister of Health must determine the composition, the place, date and time of any meeting of the National Consultative Health Forum. In terms of Section 24 of the said act, the National Consultative Health Forum must include relevant stakeholders and must meet at least once every year.

Due to its composition and interaction with numerous stakeholders within and outside the health care system, it can be deduced that the said forum plays a leading role in the sharing of health – related information. The National Consultative Health Forum can consequently play a unique role in the sharing of information related to the surveillance and control of avian influenza within and outside the national health system. In the next section the role of the Deputy Director of Health will be discussed.
2.3.2.5. The Deputy Director-General of Health

The Director-General of Health of the National Department of Health is assisted by four Deputy Directors. The organisational structure of the Director-General’s office is set out below as well as in Annexure Seven (National Department of Health, 2007).

There are four branches within the Director Genera’s office. These are listed below:

• The Deputy Director-General: Corporate Services;
• the Deputy Director-General: Health Service Delivery;
• the Deputy Director-General: Human Resources; and
• the Deputy Director-General: Strategic Health Programmes.

The Deputy Director-General: Health Service Delivery has the responsibility to co-ordinate the activities of the sub-directorates within her/his portfolio. Six service delivery clusters fall under the control of his/her office, namely:

• Health Information, Research and Evaluation;
• Primary Health Care, Districts and Development;
• Non-communicable diseases;
• Office of Standards Compliance;
• Hospital Services; and
• Health Economics.

The above mentioned service delivery cluster Primary Health Care, District and Development is separated into five divisions. These are listed below:

• Environmental Health;
• Health Promotion;
• Districts and Development;
• Personal Development and Primary Health Care; and
• Integrated Primary Health Care.

The Deputy Director-General: Health Service Delivery is the person that must promote, facilitate and provide health services related to avian influenza control and surveillance through the service delivery cluster of Primary Health Care, District and Development. The National Directorate: Environmental Health is a division in the service delivery cluster Primary Health Care, Districts and Development. The next section will discuss the function of the National Directorate: Environmental Health.

2.3.3. The place and role of environmental health within the National Department of Health

Environmental health is a division of the cluster Primary Health Care, Districts and Development under the Deputy Director-General: Health Service Delivery (National Department of Health, 2006). According to the White Paper for the Transformation of the Health System in South Africa (National Department of Health, 1997), the Director: Environmental Health of the National Department of Health is responsible for the overall co-ordination and development of national environmental health policies, norms and standards. The fulfilment of the above-mentioned responsibilities will ensure that basic environmental needs are met and that factors adverse to health are minimized.

From the above it can be concluded that the Deputy Director-General of Health Service Delivery has to rely on the Director: Environmental Health to supply her/him with the necessary environmental health information, including information on the status of avian influenza in South Africa. In the next two sections the roles of the National Consultative Health Forum and the Director: Environmental Health within the National Department of Health will be discussed.

According to Wild (personal communication, May 7, 2007), information relating to environmental health service delivery within the provincial and local
government sphere is imperative to enable the said Director to co-ordinate environmental health services from a national perspective as well as to develop relevant policies, norms and standards. A deduction that can be made is that the immediate source for environmental health information from a national perspective is the Director: Environmental Health. A further deduction is that the Minister of Health must account to cabinet and parliament on the status of avian influenza in South Africa. Such information will be provided by the Director: Environmental Health to the Director General via the Deputy Director-General of Health Service Delivery. The Director General can then present the information to the Minister of Health. As established earlier (see section 2.3.2.2), the National Health Council can also present the information to the Minister.

The Director: Environmental Health therefore plays a key role in the development of quality environmental health services at both provincial and local spheres. Various decisions have to be made based on information related to environmental health service delivery at provincial and municipal spheres, decisions which may directly affect the quality of services rendered. According to Bezana (personal communication, June 10, 2007), the Director: Environmental Health of the National Department of Health have to rely on the provincial health departments (environmental health in the provincial sphere of government) to supply him/her with environmental health-related avian influenza information (including avian influenza). In the next section the organisational structure of the Provincial Health Departments will be discussed. From the analysis of the organizational structure of the national sphere of government the following inadequacies / shortcomings were identified:

- The time that it takes for information to reach the Minister of Health is problematic. The Director: Environmental Health is not on a daily basis in contact with the Minister of Health. Urgent environmental health information from the Director: Environmental Health to the Minister of
Health must first be relayed via many formal structures. It can therefore be deduced that the formal lines of communication are very time consuming. Communication systems should be developed that will allow the Director: Environmental Health to communicate urgent environmental health information directly to the Minister.

- Clear national guidelines need to be established for situations when emergencies arise.

In the next section the organisational structure of the Provincial Health Department will be discussed.

2.3.4. **The organisational structure of the Provincial Health Departments**

The Republic of South Africa has nine provinces, namely the provinces of the Eastern Cape, Free State, Gauteng, KwaZulu-Natal, Mpumalanga, Northern Cape, Limpopo, North West and the Western Cape. The legislative authority of each province is vested in its provincial legislature. The executive authority of a province is vested in the Premier of that province who exercises his or her powers together with the other members of the Executive Council (South Africa, 1996).

The Executive Council of a province consists of the Premier and other members appointed by the premier. The Premier assigns powers to each member. According to Section 125 (2)(a) and (2)(b) of the Constitution of the Republic of South Africa Act, 1996 (Act 108 of 1996), a Premier of a province exercises the executive authority, together with the other members of the Executive Council, by implementing provincial and national legislation, which also includes legislation related to health services in a province. The provincial legislature shares concurrent legislative powers with parliament over the list of matters in Schedule 4 of the Constitution (See Annexure Eight). Schedule 4 includes *inter alia*, municipal health services, health services, animal control and diseases, pollution control, etc. The Provincial Health Departments in the Republic of South Africa are therefore, in terms of the Constitution, compelled to render environmental health services and hence services that promote the
surveillance and control of avian influenza. The next section will discuss a Provincial Health Department.

2.3.4.1. **A Provincial Health Department**

In terms of Section 25 of the *National Health Act*, 2004 (Act 63 of 2003) it is incumbent upon a provincial health department, within the framework of national policies, to promote and monitor the health of the people in the province and to develop and support a caring and effective provincial health system. Provinces must give effect to their constitutional mandate by the establishment of a province-wide district health system based on the principles of primary health care (National Department of Health, 1997). According to Hall, Haynes & McCoy (2002, pp.10-11), the organisational structure of health care service delivery may differ amongst provinces due to different provincial legislation. The next section will discuss the Member of the provincial executive committee responsible for health and the provincial legislature.

2.3.4.2. **Member of the provincial executive committee responsible for health and the provincial legislature**

In terms of Section 26 of the *National Health Act*, 2004 (Act 61 of 2003), the relevant member of the Provincial Executive Council (MEC) must ensure the implementation of national health policy, norms and standards in his or her province. According to Slabbert (2002, p.14), the MEC responsible for Health is accountable to the provincial legislature for the exercise of powers and the performance of functions within a provincial health department. Furthermore, the MEC must provide the provincial legislature with full and regular reports concerning matters under his / her control.

The inference drawn from the above is that the MEC for Health is the person that is accountable to the provincial legislature for the effective rendering of environmental health services and has to provide the legislature with full and regular reports regarding the monitoring and co-ordination of environmental
health services within the province. The implication of the above is that the MEC for Health must at all times be aware of the status of the environmental health services that are being rendered within the province. The provincial legislature therefore relies on the MEC of Health for factual information on the surveillance and control of avian influenza. The next section will discuss the role of the Provincial Health Council where it has to assist and advise the MEC of a province.

2.3.4.3. **Provincial Health Council**

According to Section 27 of the *National Health Act*, 2004 (Act 61 of 2003), a Provincial Health Council must advise the MEC on a number of health-related issues. The Provincial Health Council of a province is chaired by the MEC for Health who is accountable to the provincial legislature. Section 26 of the said act states that every Provincial Health Council consists of:

- The relevant member of the Executive Council, or his or her nominee, who acts as chairperson;
- one councillor from each of the metropolitan municipalities in the province, if there are such municipalities in the province in question;
- one councillor from each of the district municipalities in the province;
- the head of the provincial department. In the case of the Eastern Cape province this person is referred to as the Superintendent General. (Eastern Cape Department of Health, 2007);
- not more than three representatives involved in the management of local government; and
- any other person whom the relevant MEC considers appropriate.

A Provincial Health Council must, at the request of the MEC, or on its own accord, advise the relevant member of the executive council on policy concerning any matter that will protect, promote, improve and maintain the health of the population within the province. Some of these matters, according to Section 27 of the *National Health Act*, 2004 (Act 61 of 2003) include:
• Epidemiological surveillance and monitoring trends with regard to major diseases and risk factors for disease, i.e. avian influenza;
• targets, priorities, norms and standards relating to the equitable provision and financing of health services;
• efficient co-ordination of health services within the province and between neighboring provinces;
• human resources planning, production, management and development;
• equitable financial mechanisms for the funding of health services; and
• obtaining, processing and the use of statistical returns.

A Provincial Health Council must also, via the relevant MEC, annually prepare and submit to the National Department of Health, strategic medium-term health and human resource plans for the exercise of the powers of, the performance of the duties of, and the provision of health services in the province by the Provincial Health Department (ANC, 1994, p.66). In order for members of the Provincial Health Council to give effect to the legislation as mentioned above, they require a considerable amount of environmental health information, including information concerning the surveillance and control of avian influenza.

According to Section 28(1) of the National Health Act, 2004 (Act 61 of 2003), the relevant member of the Executive Council (MEC) must establish a consultative body for his or her province to assist the Provincial Health Council with health information that can be used in policy-making. Such a provincial consultative body must promote and facilitate interaction, communication and the sharing of information on provincial health issues between representatives of the provincial department and provincial and municipal organisations identified by the relevant member of the Executive Council. A provincial consultative body must include all relevant stakeholders.

Since the provincial consultative bodies consist of members who do not have sufficient knowledge on issues pertaining to environmental health, they have
to investigate such issues and report their findings to the Provincial Health Council. The relevant information concerning environmental health service delivery in a province could be obtained via sources that will be discussed in the sections that follow. The sources reflect the situation within the Eastern Cape province and can differ from post structures and designations within other provinces. However, other provinces would be able to identity similar post structures / designations with similar functions as those found in the Eastern Cape Provincial Health Department. The next section will discuss the Chief Directorate: District Health Services of the Eastern Cape Provincial Department of Health.

2.3.4.4. Chief Directorate: District Health Services

The organisational structure of the Superintendent General’s office is set out in Annexure Nine and illustrates the place of the Chief Directorate: District Health Services in the Eastern Cape Provincial Health Department (Eastern Cape Department of Health, 2007). The Chief Directorate: District Health Services reports to the Deputy Director General: Health Cluster.

The purpose of the Chief Directorate: District Health Services is to develop, monitor and evaluate the rendering of District Health Services. The said Chief Directorate has the following functions (Sikweza, personal communication, August 7, 2007):

- Develop, monitor and evaluate the functioning of hospitals in terms of clinical issues;
- Develop, monitor and evaluate the rendering of local service areas, in terms of clinical issues;
- Monitor and evaluate the functioning of Primary Health Care Services;
- Ensure and monitor the management of Health Promotion and Healthy Lifestyle Programmes; and
- Ensure and monitor the rendering of Integrated Nutrition Programme Services.
The Chief Directorate: District Health Services has the responsibility to coordinate the activities of the sub-directorates within her/his portfolio. Five service delivery clusters fall under the control of the Chief Directorate: District Health Services, namely (Sikweza, personal communication, August 7, 2007):

- Directorate: District Hospital Management;
- Directorate: District Development;
- Directorate: Primary Health Care Programmes;
- Directorate: Health Promotion and Healthy Life Styles; and
- Directorate: Mother, Child, Women’s Health and Integrated Nutrition Programmes.

The service delivery cluster of Primary Health Care, District and Development is divided into the following divisions (Sikweza, personal communication, August 7, 2007):

- Oral Health;
- Environmental Health;
- Occupational Health;
- Traditional Services; and
- Mental Health, Substance Abuse, Chronics and Geriatrics.

From the above can be concluded that the Chief Directorate: District Health Services in the Eastern Cape Provincial Health Department is the person responsible for developing, monitoring and evaluating the rendering of District Health Services in the province. Several health service delivery structures have been established to assist the Chief Directorate: District Health Services in the execution of his/her functions. In the next section the place and role of environmental health within the Provincial Health Departments are discussed.
2.3.5. The place and role of environmental health within the Provincial Health Department

From Section 2.3.4.4. the place of Environmental Health has been identified as a division within the Directorate: Primary Health Care Programmes. The structure responsible for Environmental Health in the Eastern Cape province is the Sub-Directorate: Environmental Health which is lead by the Deputy Director: Environmental Health.

The role of the Deputy Director: Environmental Health is to take full responsibility for the effective rendering of environmental health services throughout the province (Wild, personal communication, May 7, 2007). Wild states that a further role of the said sub-directorate is to monitor and coordinate the environmental health related functions that have been delegated to municipal government which include the surveillance and control of avian influenza as listed in Section 1 of the National Health Act, 2004 (Act 61 of 2003).

From an environmental health perspective, the Director: Primary Health Care, District and Development has to rely on the Deputy-Director: Environmental Health to provide the necessary information that will enable him/her to inform the Chief Directorate: District Health Services on the status of Environmental Health in the province. The Deputy-Director Environmental Health is the key functionary that co-ordinates Environmental Health services in the Eastern Cape province (Bezana, personnel communication, February 14, 2007). The office of the Deputy-Director: Environmental Health in the province of the Eastern Cape is the centre from which all environmental health services in the province are coordinated. The said Deputy-Director accounts to the Director: Primary Health Care, District and Development on issues related to the development, coordination and monitoring of local government environmental health services and the development of provincial environmental health policy. In general, the Deputy-Director will have to account for all strategies introduced to ensure that the municipalities within the
provinces render an effective and efficient environmental health service (Bezana, personnel communication, February 14, 2007).

It can therefore be concluded that the Deputy-Director: Environmental Health must have a thorough knowledge of the status of avian influenza in the province in order to assist the Chief Directorate: District Health Services in the execution of his/her duties. Furthermore, the Deputy-Director: Environmental Health works in partnership with the Director: Primary Health Care, District and Development as well as with environmental health practitioners at the municipal sphere of government. The Deputy Director: Environmental Health has to rely on the environmental health practitioners in the municipal sphere of government to make available information pertaining to the surveillance of avian influenza. Such information will enable her/him to make informed decisions from a provincial perspective that can assist in the formulation of effective policies for the surveillance and control of avian influenza within the province. From the analysis of the organizational structure of the provincial sphere of government the following inadequacies / shortcomings were identified:

- The time that it takes for information to reach the relevant member of the Provincial Executive Council of Health (MEC) is problematic. The Deputy-Director: Environmental Health is not on a daily basis in contact with the MEC. Urgent environmental health information from the Deputy-Director: Environmental Health to the MEC must first be relayed via many formal structures. It can therefore be concluded that the formal lines of communication are very time consuming. Communication systems must be developed that allow the Deputy-Director: Environmental Health to communicate urgent environmental health issues directly to the MEC.
- Unambiguous provincial guidelines need to be established for situations when emergencies arise.

In the following section, the organisational structure of the District Health System will be discussed.
2.3.6. The organisational structure of the District Health System
In order to identify the environmental health decision-makers in the municipal sphere of government it becomes necessary to analyse the organisational structure of the district health system as it applies to South Africa. In order to facilitate a meaningful discussion an explanation is firstly given of what is meant by a district health system.

2.3.6.1. The District Health System
According to the Limpopo Provincial Health Department (2004, p.2), a district health system is part of a national health system which is a vehicle for providing quality primary health care services to a defined geographic area in which individuals, communities and providers participate in processes directed at improving their own health through accessible, equitable and affordable means. According to the Limpopo Provincial Health Department (2004, p.4), the World Health Organization describes the package of primary health care services as an all-inclusive range of services, including community and outreach services; home-based and school services; district hospitals services; personal preventive services, promotive, curative and rehabilitative services; as well as non-personal health services (environmental health service) and support services such as patient transport services.

In analysing the district health system in South Africa, Engelbrecht and McCoy (2004, p.2), highlighted three distinctive features regarding the district health system and these are summarised below.

Engelbrecht and McCoy (2004, p.2), argue that the district health system must first be regarded as a means to an end, rather than an end in itself. In this instance, the district health system is the "means" to achieve the "end" of an equitable, efficient and effective health system based on the principles of the primary health care approach. The features, elements and conceptual framework of the primary health care approach should therefore be reflected in the nature and design of the district health system. This means that the
district health system is more than just a structure or form of organisation, but is also the manifestation of a set of activities such as community involvement, integrated and holistic health care delivery; inter sectoral collaboration and a strong "bottom-up" approach to planning, policy development and management.

A second feature made by Engelbrecht and McCoy (2004, p.2), is that it should be understood that the primary health care approach and the district health system model apply to the whole of the health system and at all levels of health care delivery. They do not just apply to the "primary" or district level of the health system, as is commonly implied and understood. In a district health system, the organisation and management of the entire health system is district-based, meaning that even policy areas such as health sector financing, utilisation of regional and tertiary hospitals, the relationship with the private sector and governance should be district health system-based or district health system-centered. In other words, the health district and its management structure should be the core building block of the entire health system. Too often however, the district health system is understood as one component of the national health system rather than the underlying framework for the organisation of health care as a whole.

A third feature made by Engelbrecht and McCoy (2004, p.2), is that the essence of the district health system is the organisation of health care according to the geographical sub-divisions of a country which are managed through a decentralised management structure. The district management structure is supposed to be the point and level at which different health service activities are integrated into a comprehensive and holistic approach to health care. For example, community-based and facility-based health activities would be implemented as different components of a single health plan for a given population and area. This is in contrast with a health system primarily organised according to specific health services (e.g. a nation-wide family planning programme operating through a centralised and vertical
management system), or according to non-geographic population groups (e.g. health care services organised by race or by class).

According to Engelbrecht and McCoy (2004, p.4), the district health system therefore represents a truly profound break from the apartheid health system that was characterised by fragmentation, inefficiency, centralised authoritarianism and the separation of curative and preventative services. In the following section, a health district, that represents municipal government from a health perspective, is firstly explained.

2.3.6.2. Health District
According to Section 21 of the National Health Act, 2004 (Act 63 of 2003), the district health system consists of various health districts, and the boundaries of health districts coincide with district and metropolitan municipal boundaries. According to Owen (1995, pp.6-7), the National Department of Health used the World Health Organization’s definition of a Health District in its strategy for the development of a district health system for South Africa. This definition states that a health district is a more or less self contained segment of the national health system. It comprises first and foremost a well-defined population, living in a clearly delineated administrative and geographical area, whether urban or rural. A health district must be large enough to be economically efficient, but small enough to ensure effective management which is accountable to local communities. Geographically, every part of a country will be encompassed within a health district, the boundaries of which should not cross the boundaries of other administrative sectors, of local governments, or of magisterial districts - they should be coterminous with other boundaries (Owen, 1995, p.7).

In order to fulfill the above-mentioned strategy for a district health system in South Africa, the provincial health departments, in terms of their own provincial health legislation, divided their provinces into a number of geographically coherent, functional health districts; whose boundaries are
coherent with Category A (metropolitan) and Category C (district) municipalities (Constitution of the Republic of South Africa Act, 1996 (Act 108 of 1996)). Each metropolitan and district municipality is thus known as a Health District (Owen, 1995, p.7). In the next section a District Health Council will be discussed.

2.3.6.3. District Health Council

It is the task of the relevant member of the executive council (MEC of a provincial health department), after consultation with the member of the executive council responsible for local government in the province in question, and the municipal council of the relevant metropolitan or district municipality, to establish a district health council for every health district in his or her province (Section 21 of the National Health Act, 2004 (Act 63 of 2003)). A district health council consists of the following members:

- A member of the metropolitan (Category A) or district (Category C) municipal council, who will chair the council;
- a person appointed by the relevant member of the executive council of the related province to represent her / him;
- a member of the council of each local municipality (Category B) within the health district; and
- not more than five other persons, appointed by the relevant member of the executive council after consultation with the municipal council of the metropolitan or district municipality, as the case may be.

According to the Section 21 of the National Health Act, 2004 (Act 63 of 2003), the functions of a district health council are to promote co-operative governance, to ensure co-ordination of planning, budgeting, provision and monitoring of all health services that affect the residents of that health district. In addition, it must provide services that affect the residents of that health district. It must also advise the relevant member of the executive council though the provincial health council and the municipal council of the relevant
metropolitan or district municipality on any matter regarding health or health services in that health district.

Provincial legislation must provide for the approval, after consultation with the district health council, by both the relevant member of the executive council and the municipal council of the metropolitan or district municipality of the provincial and municipal components respectively, of the detailed budget and performance targets for health services in the health district to which both the provincial and municipal spheres of government will contribute. Each district and metropolitan municipality must also, by 31 March each year, develop and present to the relevant member of the executive council, a district health plan drawn up in accordance with national and provincial policies and guidelines and the requirements of the relevant integrated development plans prepared in terms of the Local Government Municipal Systems Act, 2000 (Act 32 of 2000).

From the above it can be deduced that a district health council is responsible for the overall coordination and development of health service delivery at the municipal sphere of government. A further deduction that can be made is that the district health council is a key structure that must be kept in mind in developing work methods and procedures for the surveillance and control of avian influenza. A health district can be legally divided into a number of health sub-districts which will be discussed in the next section.

2.3.6.4. A Health Sub-district

In terms of Section 30(2) of the National Health Act, 2004 (Act 63 of 2003), a health district can be divided into health sub-districts to accomplish the principles laid down in Sections 27 and 195 of the Constitution of the Republic of South Africa Act, 1996 (Act 108 of 1996), as well as the criteria set out in Section 25 of the Local Government Municipal Demarcation Act, 1998 (Act 27 of 1998). The purpose of health sub-districts is to devolve comprehensive health care management autonomy and control to the lowest level, compatible
with rational planning, administration and the maintenance of good quality care (National Department of Health, 1997, p.9).

Both a metropolitan (Category A) and district (Category C) municipality, as previously explained, are classified as health districts. In a metropolitan municipality, a metropolitan sub-council is the term used to denote the first sub-division of that area. In terms of health care delivery, this sub-structure is referred to as a health sub-district (Wilson, 1994, p.4). A metropolitan sub-council (health sub-district) consists of the political representatives, or councilors representing the wards included in the sub-council area. The sub-council has such duties and powers as the metropolitan council may delegate to it and it may make recommendations to the metropolitan council on any matter affecting environmental health within its wards (Wilson, 1994, p.5). An example of the division of a metropolitan (Category A municipality) into health sub-districts is the Nelson Mandela Metropolitan Municipality in the Eastern Cape province that is divided into three health sub-districts, namely:

- Sub-district A - Motherwell and surrounding townships;
- Sub-district B - Uitenhage and Dispatch; and
- Sub-district C - Central Port Elizabeth, Walmer and the Northern Suburbs of Port Elizabeth (Oliphant, personal communication, February 7, 2007).

A district municipality, in contrast with a metropolitan municipality, must establish within its area, internal municipal service districts to facilitate the provision of municipal services in the said parts of the municipality (Local Government Municipal Systems Act, 2000 (Act 32 of 2000). In terms of health care service delivery, these municipal service districts are also referred to as health sub-districts (Wilson, 1994, p.4).

When a district municipality establishes an internal municipal service district (health sub-district), it must establish a committee for each of the service
districts (health sub-districts). The latter is composed of persons representing the community in the municipal service district who act as a consultative and advisory forum for the district municipality regarding the management of, and other matters relating to the service in the service district (health sub-district). Health sub-district managers have been appointed at local municipalities. The sub-district managers are responsible for the effective implementation of health sub-districts in a health district (Oliphant, personal communication, February 7, 2007). The next section will discuss a local municipality.

2.3.6.5. **A Local Municipality**

A local municipality is defined, in terms of Section 1 of the *Local Government Municipal Structures Act*, 1998 (Act 117 of 1998), as a municipality that shares municipal executive and legislative authority in its area with a district municipality (Category C municipality) within whose area it falls, and which is described in Section 155 (1) (b) of the *Constitution of the Republic of South Africa Act*, 1996 (Act 108 of 1996) as a Category B municipality. In terms of health care service delivery, these municipalities are referred to as sub-units of a health sub-district of a Category C municipality.

An example of the division of a Category C municipality into health sub-districts, and the division of those health sub-districts into local municipalities is Cacadu District Municipality (also referred to as Cacadu Health District – a Category C municipality) in the Eastern Cape province that has been divided into three health sub-districts, namely Camdeboo, Makana and Kouga. Each of these health sub-districts is further divided into local municipalities. For example, Kouga Health Sub-District has been divided into two local municipalities (Category B municipalities), namely Kouga and Koukamma (Dreyer, personal communication, February 19, 2007).

In the Ukhahlamba district municipality (also referred to as Ukhahlamba Health District – a Category C municipality) in the Eastern Cape province a different arrangement prevails. In line with the new municipal boundaries,
a restructuring of the health services took place in this Category C municipality. According to Agenbag (2005, p.28), the Ukhahlamba district municipality is composed of four local municipalities (Category B), namely Maletswai, Gariep, Senqu and Elundini. Based on the size of the population, three Local Service Areas were formed namely; Elundini, Senqu and Maletswai/Gariep (see Annexure Ten).

In terms of Section 16 of the Local Government Municipal System Act, 2000 (Act 32 of 2000), local (Category B) municipalities must develop a culture of municipal governance that complements formal representative government with a system of participatory governance. For this purpose, local municipalities must encourage and create conditions favourable for the local community to participate in the affairs of the municipality, including strategic decisions relating to the provision of environmental health services by the relevant Category C municipality with whom it shares its municipal executive and legislative authority (Maarschalk, 2003, p.136). The next section will discuss the place and role of environmental health within the district health system.

2.3.7. The place and role of environmental health within the district health system

From the discussion of the district health system above it was said that the district health system is the vehicle for the delivery of primary health care services which includes environmental health services. It was also said that environmental health services are defined as municipal health services and that municipal health services are rendered within health districts by Category A and Category C municipalities. Furthermore, each health district (Category A and C municipalities) has a district health council.

To assist the members of a district health council to make informed decisions regarding environmental health services, they will require sufficient information. According to Dreyer (personnel communication, 19 February
2007) each district health council has a District Environmental Health Manager who is responsible for the co-ordination of environmental health service delivery as well as the provision of environmental health information to the district health council. To be able to effectively perform this function, this official has to rely on the health sub-districts which are situated within the health district to provide the information.

The function of the district and metropolitan municipalities (health districts) is to coordinate and to support the health sub-districts within their areas of jurisdiction (Wilson, 1994, p.5). Each health-sub district of a metropolitan and district municipality has an environmental health manager who is responsible for the coordination of environmental health service delivery within the area of the health sub-district. The said environmental health manager is also responsible for the provision of information to the decision-makers of the health sub-district and district or metropolitan municipality. From a health sub-district of a metropolitan (Category A) municipality’s perspective, this official will be able to obtain the required information from the environment health practitioners who work within that health sub-district. From a health sub-district of a district (Category C) municipality perspective, the official will be able to obtain the required information from the environmental health practitioners who work at the local municipalities situated within the area of jurisdiction of the health sub-district (Oliphant, personal communication, February 14, 2007).

From a local municipality’s perspective it can be concluded that the members of a local municipal council will require sufficient environmental health information to enable them to make informed decisions from a local municipal council’s perspective. Each local municipality is allocated an environmental health manager who is employed by the relevant health district (Category C) municipality. A function of this official is to provide the members of the relevant local municipal council, as well as the relevant health sub-district environmental health manager with sufficient environmental health information
to enable them to make informed decisions on issues pertaining to environmental health that may affect the local municipality. This official will also render, together with environmental health practitioners employed by the relevant district municipality, environmental health services within the area of jurisdiction of that local municipality. These environmental health practitioners, as well as those employed by the district health councils of the metropolitan municipalities and who work within the health sub-districts of the metropolitan municipalities could be seen as the first link in a chain that stretches from the community where they work, to parliament, being the national policy-making body on issues pertaining to environmental health service delivery in South Africa. According to Titus (personnel communication, December 15, 2006) it often happens that the value of an environmental health practitioner’s role is acknowledged only when disaster or disease strikes, yet health budgets at all spheres of government can be reduced through preventative environmental health measures and timeous monitoring.

From the above it can be deduced that environmental health services are vested in the municipal sphere of government as municipal health services. The role that environmental health plays at this sphere of government comprises the functions as discussed in section 2.2.2.

2.4. Conclusion
The development of detailed environmental work methods and procedures for the surveillance and control of avian influenza in the Eastern Cape province requires a comprehensive understanding of the national health care system within which environmental health practitioners operate. This chapter has attempted to describe the national health care system and to identify the place and role of environmental health practitioners within the national, provincial and municipal spheres of government.

It was found that the right to health care services is well established within the Constitution of the Republic of South Africa Act, 1996 (Act 108 of 1996). The
South African government follows the primary health care philosophy of health care delivery which includes non-personal health care services, namely environmental health services. The environmental health profession has a constitutional obligation to protect the people of South Africa against environmental factors (physical, chemical, biological and social factors) that pose a risk to human health. The development of detailed environmental health work methods and procedures for the surveillance and control of avian influenza can therefore be regarded as an attempt to fulfill this constitutional imperative.

It was found that the promulgation of the National Health Act, 2004 (Act 61 of 2003), provides the legislative framework for the state to unite the various elements of the national health system in a common goal and to actively promote and improve the national health system in South Africa. The said act delineates the organisational framework for health care service delivery within each of the three spheres of government in South Africa.

The promulgation of the National Health Act, 2004 (Act 61 of 2003), put to rest the confusion that prevailed previously as to what is meant by environmental health services. Although there is still not a formal definition of environmental health in South Africa, a better understanding exists of what is meant by environmental health services. It was further concluded that municipal health service is environmental health service and includes the list of municipal health services as listed in Section 1 of the National Health Act, 2004 (Act 61 of 2003). A further finding was that avian influenza surveillance and control is an activity under the services: surveillance and prevention of communicable diseases as listed in Section 1 of the said act.

The analysis of the national health care system enabled the identification of a number of decision-makers within the three spheres of government. The decision-makers can have an influence on environmental health service delivery and therefore play either a direct or indirect role in the surveillance
and control of avian influenza. The analysis of the organisational structure of the national department of health enabled the identification of the following decision-makers:

- The Minister of Health and the Cabinet;
- members of the National Health Council;
- the National Health Advisory Committee;
- the Director-General of Health;
- the Deputy Director-General: Health Service Delivery;
- the Director: Environmental Health; and
- the National Consultative Health Forum.

From the analysis of the organizational structure of the national sphere of government it was found that the time it takes for information to reach the Minister of Health is problematic. The formal lines of communication are very time consuming. Communication systems should be developed that allows the Director: Environmental Health to communicate urgent environmental health information directly to the said Minister.

It was pointed out that the environmental health decision-makers within the provincial sphere of government (Provincial Department of Health as in the case of the Eastern Cape provincial health department) include the:

- Members of the Provincial Executive Committee responsible for health and the Provincial Legislature;
- Provincial Health Council;
- the Chief Director: District Health Services;
- the Director: Primary Health Care, District and Development; and
- the Deputy-Director: Environmental Health.
From the analysis of the organizational structure of the provincial sphere of government the deduction was made that the time it takes for information to reach the relevant member of the Provincial Executive Council of Health (MEC) is problematic. The official lines of communication are very time consuming. Communication systems should be developed that allow the Deputy-Director: Environmental Health to communicate pressing environmental health issues directly to the member of the executive council. Unambiguous provincial guidelines need to be established for situations when emergencies arise.

To be able to identify the environmental health decision-makers within the municipal sphere of government it was essential to do an analysis of the organisational structure of the district health system as it applies to the municipal sphere of government in South Africa. It was therefore necessary to explain what is meant by Health District, District Health Authority, District Health Council, a Health Sub-district and a Local Municipality.

What became evident from interviews conducted with environmental decision-makers at the municipal sphere of government is that municipalities must be encouraged to budget appropriately for strategies of avian influenza surveillance and control. The said municipalities must address avian influenza preparedness plans as an integral part of their annual integrated development plans. It was also found that all too often the value of an environmental health practitioner’s role is acknowledged only when disaster or disease strikes, yet health budgets at all spheres of government can be reduced through preventative environmental health measures and timeous monitoring.

From interviews conducted during the study it was discovered that a need exists for the education of all role players on avian influenza and the training of environmental health practitioners on detailed work methods and procedures for the surveillance and control of the disease. Liaison and communication networks need to be strengthened amongst local
municipalities in an attempt to monitor and identify outbreaks at an early stage.

The surveillance and control of a disease is dependent on its epidemiology. The epidemiology of avian influenza will be presented in the next chapter.
CHAPTER THREE
THE EPIDEMIOLOGY OF AVIAN INFLUENZA

3.1. Introduction

The surveillance and control of a disease is dependent on its epidemiology. It is therefore important, when attempts are made to develop or improve existing work methods and procedures, to have a thorough knowledge of the epidemiology of the disease. Therefore a literature study on the disease condition and a demarcation of its relevant aspects is presented.

Firstly, attention will be given to influenza as a disease and the variability of the virus. Secondly, the difference between human seasonal influenza, avian influenza and human pandemic influenza will be presented. Thirdly, the natural hosts and sources of the virus will be discussed. Fourthly, attention will be given to the clinical presentation of the virus in people and animals. This will be followed by the transmission of the virus and its occurrences. Lastly discussed are risk assessment, the possible impact of an avian influenza pandemic and the different phases of pandemic influenza.

The resources used for this part of the study consist of mainly documents from the World Health Organization, the National Department of Health, relevant literature from the internet, as well as the Pandemic Preparedness and Response Plans from the Provincial Departments of Health in South Africa. In the next section an attempt will be made to define influenza.

3.2. Definition of Influenza

The Free Dictionary (2007) describes Influenza as an acute contagious viral infection characterized by inflammation of the respiratory tract and by fever, chills, muscular pains, and prostration. Included are any of the various viral infections of animals, characterized generally by fever and respiratory involvement.
According to Prescott, Harley and Klein (1996), influenza, or flu, is a respiratory system disease caused by orthomyxoviruses which is characterised by chills, fever, headaches, malaise, and general muscular aches and pains. The National Department of Health (2006) in South Africa describes influenza or 'flu' as a respiratory illness associated with infection by an influenza virus. Symptoms frequently include headache, fever, cough, sore throat, aching muscles and joints. There is a wide spectrum of severity of illness ranging from minor symptoms through to pneumonia and death.

From the above it can be concluded that influenza is an acute contagious respiratory illness associated with infection by the influenza virus of the family Orthomyxoviridae. The illness can be present in human and in animals. The severity of the illness can range from mild to fatal. Symptoms frequently include headaches, aching muscles and joints, malaise, fever, chills, cough, sore throat and prostration. The next section provides a description of the virus.

### 3.3. **Description of the influenza virus**

According to the National Department of Health (2006), the influenza virus is genetically highly variable. It is this variability that gives rise to constant changes in its antigenicity. The genetic variability of the virus is common in most Ribonucleic Acid [RNA] viruses. A characteristic of the virus is that the antigenic changeability constantly gives rise to new strains. The epidemiology of the virus is thus characterised by a constant arrival of new antigenic strains, resulting in recurring outbreaks or epidemics.

A unique feature of the virus is the frequency with which changes in antigenicity occur. Alterations of the antigenic structure can lead to infection in humans by variants of the virus to which little or no resistance is present in the population at risk. This explains why influenza continues to be a major epidemic disease and frequently produces wide pandemics (Prescott, et al., 1996, p.740).
From the above it can be deduced that the influenza virus is genetically extremely variable and it is this variability that gives rise to regular modification in the antigenicity of the virus. The antigenic changeability constantly gives rise to new strains, resulting in frequent outbreaks or epidemics. Next presented is the classification of the influenza virus.

3.4. **Classification of the influenza virus**

The influenza virus can be classified into three types, based on the antigenicity (the ability of a substance to trigger an immune response in a particular organism) of surface nucleoprotein proteins, which surrounds the RNA genome of the virus. The three types of influenza viruses are referred to as Type A, Type B and Type C. All three types of influenza viruses are infectious but they differ in severity (Prescott, et al., 1996 p.740).

According to the Biology Online Dictionary (2007), the Type A virus is the cause of pandemics. This virus can infect other mammals and birds; Type B virus only affects humans and the Type C virus causes only a mild infection in humans. According to Schoub and Martin (2006, p.20), the Type A influenza virus is further divided into subtypes based on the antigenicity of the two proteins embedded in the envelope of the virus, which are used to attach to the host cell and to penetrate into the host cell. These are haemagglutinin (HA), (so named because the protein agglutinates red blood cells which form the basis of the serological test to identify the virus using specific antisera - the haemagglutination inhibition or HI test) and neuraminidase (NA) (so named because this protein is an enzyme which digests the neuraminic acid receptor of the cell to allow the attached virus to penetrate into the cell). Sixteen different HA viruses and nine different NA's have been identified in various combinations in wild aquatic birds, the reservoir host for influenza viruses. Only three subtypes are known to infect humans and these are H1N1, H2N2 and H3N2. At present two of the subtypes are circulating in humans, namely H1N1 and H3N2.
Each of the Type A subtypes as well as the Type B subtype are, in turn, subdivided into strains based on the antigenicity of the HA protein. The strains are designated according to a formula which describes the full pedigree, i.e. its type, geographical location of where it was first isolated and the year of isolation. Hence the virus strains incorporated into the 1997 vaccine were designated as A/Texas/36/91 (H1N1), A/Wuhan/359/95 (H3N2), B/Beijing/184/93 or B/Harbin/07/94. The additional number before the year of isolation is merely a laboratory identification number (Schoub & Martin, 2006, p.25).

From the above it can be concluded that the influenza viruses can be classified into three types based on the antigenicity of the nucleoproteins which surrounds the RNA genome of the virus. The three types are Type A, Type B and Type C of which Type A is the most virulent and infects mammals and birds. Influenza Type A viruses can be divided into subtypes on the basis of their surface proteins - hemagglutinin (HA) and neuraminidase (NA). There are sixteen known HA subtypes and nine NA subtypes. The HA and NA surface proteins can form a number of possible combinations. In the following section the mechanism of influenza virus variability are discussed.

### 3.5. The mechanism of influenza virus variability

According to the National Department of Health (2006), there are two ways in which the influenza virus can change its antigenicity. The first one (antigenic shift) is rare but a dramatic event. The other one (antigenic drift) represents a more common and subtle change. The two ways of changing antigenicity are described below.

#### 3.5.1. Antigenic shift

The influenza virus is one of the few viruses where the individual genes occur on separate and discrete pieces of nucleic acid instead of the more usual complete single strand for the whole genome. As a result of this, if two different subtypes happen to infect the same cell, genes from different origins may be swopped when the progeny virus is put together in the assembly
phase of the virus’ replication. Usually the alien gene or genes will produce an inconsequential hybrid progeny virus which cannot survive or be propagated. This process is called reassortment and the hybrid offsprings are referred to as reassortants (Schoub & Martin, 2006, p.25).

The events during an antigenic shift and antigenic drift are illustrated in the diagram in Annexure Eleven (National Institute of Allergy and Infectious Diseases, 2007, p.2). In China and the Far East, the enormous human populations come into close contact with animal reservoirs that harbour a great variety of influenza subtypes. Nevertheless, reassortment producing a new human virus is a rare event, happening about once every 10-40 years. When it does occur, it gives rise to a completely new subtype of virus (acquiring a totally new HA and sometimes a new NA protein as well) to which the human population will be readily susceptible and this would then result in the dramatic and sudden classical pandemics such as the 1918/19 Spanish flu pandemic, the 1957 Asian flu pandemic and the 1968 Hong Kong flu pandemic. The sudden and major change in antigenicity of the virus is therefore called an antigenic shift (National Institute of Allergy and Infectious Diseases, 2007, p.1).

3.5.2. Antigenic drift
Antigenic drift is a more subtle change in the antigenicity of the HA protein - the protein involved specifically in the critical attachment of the virus to its receptor on the host cell. Thus, even subtle changes (i.e. sometimes only one or two amino acids) may enable the virus to elude the host’s immunity. These HA mutations occur readily and continually. Point mutations (i.e. substitution of one amino acid) usually do not translate on their own into a significant antigenic change. However, accumulation of these point mutations under the selective pressure of antibodies formed in innumerable human hosts will eventually produce meaningful antigenic changes, resulting in a virus which can spread throughout the human population, causing widespread epidemic activity. This more gradual but progressive change is called antigenic drift and
it gives rise to new antigenic strains of influenza, approximately every three to five years (National Department of Health, 2006, p.12).

From the above it can be concluded that there are two ways in which the influenza virus can change its antigenicity, namely antigenic shift and antigenic drift. Antigenic shift represents a sudden and major change in antigenicity that gives rise to a completely new subtype of virus (about once every 10-40 years), which can cause dramatic and sudden classical pandemics. Antigenic drift represents a gradual but progressive change which can then spread throughout the human population, causing widespread epidemic activity, approximately every three to five years. In the next section the difference between human seasonal influenza, avian influenza and human pandemic influenza are clarified.

3.6. **Difference between human seasonal influenza, avian influenza and human pandemic influenza**

According to the Western Cape Department of Health (2006), it is very important to understand that there are fundamental differences between human seasonal influenza, avian influenza and human pandemic influenza. It is therefore important that those involved in the surveillance and control of avian influenza are able to differentiate between the different types of influenza in order to develop scientifically formulated work methods and procedures for the surveillance and control of avian influenza. While avian flu is diagnosed in birds, causing illness primarily in birds and potentially leading to severe losses in the poultry industry, its direct human health implications are comparatively minor. However, it may serve as the origin of a new "human" influenza virus subtype which might then be rapidly transmitted between people and cause a human influenza pandemic.

3.6.1. **Seasonal influenza**

Influenza viruses cause outbreaks of influenza every winter season (May to August in the Southern hemisphere and November to February in the
Northern hemisphere). This is called seasonal influenza. These outbreaks are variable but usually affect between two and thirty percent of the population resulting in a variable degree of morbidity and mortality, mostly confined to elderly individuals, especially those with underlying medical conditions.

The virological mechanism behind seasonal influenza is antigenic drift. As they are transmitted from human to human (being highly contagious and therefore infecting large numbers of individuals), pre-existing immunity "drives" the selection of mutant viruses that are less well neutralised by the immune system. This leads to slight changes in the genetic make-up of circulating virus strains over time. When significant antigenic variation occurs in the circulating virus so that the population is largely susceptible, significantly greater epidemic activity occurs which is often global in extent, with varying intensity in different countries often depending on population immunity (Western Cape Department of Health, 2006). Discussed next is avian influenza.

### 3.6.2. Avian influenza

According to the World Health Organization (2005a), avian influenza is an infectious disease of birds caused by the Type A strain of the virus. All birds are thought to be susceptible to infection with avian influenza. Avian influenza infection in birds causes a wide spectrum of symptoms, ranging from mild illness (low pathogenicity) to a highly contagious and rapidly fatal disease resulting in severe epidemics. This is known as “highly pathogenic avian influenza” (HPAI) which is characterized by a sudden onset, severe illness, and rapid death of affected birds/flocks. The mortality rate can reach 100%.

According to the Center for Infectious Disease Research and Policy (2006), avian influenza, also called fowl plague, avian flu and bird flu, is a highly contagious viral disease with up to 100% mortality in domestic fowl. The disease is caused by the influenza A virus, subtypes H5 and H7. All types of birds are susceptible to the virus but outbreaks occur most often in chickens
and turkeys. The infection may be brought about by migratory wild birds, which can carry the virus without showing any signs of the disease. Type A influenza viruses can infect several animal species aside from birds, including pigs, horses, seals and whales. Birds are an especially important species because all known subtypes of influenza A viruses circulate among wild birds, which are the natural hosts for influenza A viruses (Center for Infectious Disease Research and Policy, 2006, p.1). The Food and Agriculture Organization of the United Nations (2007, p.1) states that avian influenza viruses are members of the family Orthomyxoviridae.

Pienaar and Horner (2005, p.5) describe avian influenza as a highly contagious viral disease of domestic poultry and many species of wild birds, caused by infection with a Type A influenza virus. Type A viruses can cause infection in man, pigs, equines, birds and marine mammals. The virus has a worldwide occurrence and may occur as a low pathogenic strain (LPAI) or as a high pathogenic (virulent) strain (HPAI). The latter form is, according to the current International Animal Health Association Disease Listing, a “List A” disease and could result in mortality approaching 100% in chickens, turkeys, and guinea fowl.

The new definition of Notifiable Avian Influenza (NAI), with specific reference to the poultry industry as proposed by the International Animal Health Association, is an infection of poultry caused by any influenza A virus of the H5 or H7 subtypes, or by any avian influenza virus with an intravenous pathogenicity index (IVPI) greater than 1.2 (or as an alternative at least 75% mortality) as described below. NAI viruses can be divided into highly pathogenic notifiable avian influenza viruses (HPNAI) and low pathogenic notifiable avian influenza (LPNAI).

HPNAI viruses have an IVPI in 6-week-old chickens greater than 1.2 or, as an alternative, cause at least 75% mortality in 4 to 8 week-old chickens infected intravenously. H5 and H7 viruses which do not have an IVPI of greater than
1.2 (or cause less that 75% mortality in an intravenous lethality test) should be sequenced to determine whether multiple basic amino acids are present at the cleavage site of the hemagglutinin molecule (HA0); if the amino acid motif is similar to that observed for other HPNAI isolates. The isolate being tested should be considered as HPNAI. LPNAI are all influenza A viruses of H5 and H7 subtypes that are not HPNAI (Pienaar & Horner, 2005, p.16).

The Western Cape Department of Health (2006) states that avian influenza, or “bird flu”, is caused by different influenza virus strains that normally infect only various species of birds and less commonly other animals such as pigs. The natural reservoir of these influenza viruses is wild water birds in whom they typically do not cause disease. In domestic poultry, infection with avian influenza viruses may cause two forms of the disease. The so-called “low pathogenic form” commonly causes only mild symptoms (e.g. ruffled feathers, a drop in egg production) and may easily go undetected. The “highly pathogenic form” is far more dramatic. It spreads very rapidly through poultry flocks, causes disease, affecting multiple internal organs and has a mortality that can approach 100%, often within 48 hours. Accordingly, low pathogenic avian influenza (LPAI) viruses are distinguished from highly pathogenic avian influenza (HPAI) viruses. The latter all belong to the H5 and H7 HA subtypes, but not all viruses with those subtypes are highly pathogenic. Their occurrence has to be notified to the World Organisation for Animal Health (Office International des Epizooties, OIE); hence the terms notifiable avian influenza (NAI) and HPNAI or LPNAI (Western Cape Department of Health, 2006).

From the above it can be concluded that avian influenza, also called fowl plague, avian flu or bird flu, is a highly contagious viral disease with up to 100% mortality in domestic fowl. Avian influenza viruses are members of the family Orthomyxoviridae. All types of birds are susceptible to the virus but outbreaks occur most often in chickens and turkeys. Type A viruses can cause infection in man, pigs, equines, birds and marine mammals. Avian
influenza can be divided into two broad categories: (1) Low Pathogenic Avian Influenza (LPAI) and (2) Highly Pathogenic Avian Influenza (HPAI). Avian influenza (NAI) is an infection of poultry caused by any influenza A virus of the H5 or H7 subtypes. Low Pathogenic Avian Influenza (forms H5 and H7) subtypes have been identified in poultry in South Africa but as the name implies, they do not cause major mortality problems. To date no Highly Pathogenic Avian Influenza strain has been reported in South Africa.

3.6.3. Human pandemic influenza
According to the Western Cape Department of Health (2006), an influenza pandemic occurs when a new influenza virus subtype emerges that has not previously circulated in humans. This phenomenon may be caused by antigenic shift as a result of so-called "reassortment" of two different influenza viruses infecting the same individual (and cell) and exchanging their gene segments. Thus, a new influenza virus may emerge against which no human being has any degree of immunity. This may result in a global pandemic with high numbers of cases and deaths. Improved transport systems, rapid urbanization and increased travel are more likely to facilitate the spread of the new viruses worldwide (Western Cape Department of Health, 2006).

From the above it can be concluded that there is a fundamental difference between human seasonal influenza, avian influenza and human pandemic influenza. While avian flu is diagnosed in birds, causing illness primarily in birds and potentially leading to severe losses in the poultry industry, its direct human health implications are comparatively minor. However, it may serve as the origin of a new "human" influenza virus subtype which might be rapidly transmitted between people to cause a human influenza pandemic. Seasonal influenza viruses cause outbreaks of influenza every winter season. These outbreaks usually affect between 2-30% of the population, resulting in a variable degree of morbidity and mortality, mostly confined to elderly individuals, especially those with underlying medical conditions - Avian influenza or "bird flu", is caused by different influenza virus strains that
normally infect only various species of birds, and less commonly other animals such as pigs. The natural reservoir of these influenza viruses is wild water birds in whom they typically do not cause disease. Although avian influenza viruses are normally highly species-specific and of concern to poultry farmers and veterinary authorities, they have on comparatively rare occasions crossed the species barrier to infect humans. An influenza pandemic (global epidemic) occurs when a new influenza virus subtype emerges that has not previously circulated in humans. In the next section the natural hosts of avian influenza virus are discussed.

3.7. Natural hosts of the avian influenza virus

Avian influenza virus outbreaks occur most frequently in domestic fowl and turkeys, although ducks, geese, guinea fowl, quail and pheasants are also susceptible. A particular isolate may produce severe disease in turkeys but not in chickens or any other avian species. It would be impossible to generalize on the host range for HPAI, for it will likely vary with the isolate. This assumption is supported by reports of farm outbreaks where only a single avian species of several species present on the farm became infected. Many species of wild birds, particularly waterbirds and seabirds are also susceptible, but infections in these birds are generally subclinical (Food and Agriculture Organization of the United Nations, 2007).

According to Olsen and Munster (2006, p.14), the most important avian species that are known to carry avian influenza A viruses are ducks, geese, swans, gulls, terns, waders, and rails. Of all the avian species, ducks have been shown to have the highest prevalence for the influenza A virus.

From the above it can be concluded that domestic fowl, ducks, geese, turkeys, guinea fowl, quail and pheasants can be regarded as natural hosts of the avian influenza virus. Ducks have the highest prevalence for the influenza A virus. In the next section the sources of infection of the avian influenza virus are discussed.
3.8. **Sources of infection with the avian influenza virus**

Direct or indirect contact between domestic flocks and wild migratory waterfowl has been implicated as a frequent cause of avian influenza epidemics in poultry populations. It is generally accepted that migratory waterfowl, most notably wild ducks, are the natural reservoir of avian viruses, which can be transmitted to domestic bird populations and to commercial poultry. In the absence of good surveillance and prompt control measures, avian epidemics can last for years (World Health Organization, 2005a).

The immediate source of infection for domestic poultry can seldom be ascertained, but most outbreaks probably start with direct or indirect contact of domestic poultry with migratory waterbirds. Many of the strains that circulate in wild birds are either non-pathogenic or mildly pathogenic for poultry. However, a virulent strain may emerge either by genetic mutation or by reassortment of less virulent strains. Scientific evidence indicates that the former mechanism of infection occurred in 1983-87 in the Eastern United States (Food and Agriculture Organization of the United Nations, 2007).

Swine appear to be important in the epidemiology of infection of turkeys with swine influenza virus when they are in close proximity. Other mammals do not appear to be involved in the epidemiology of HPAI. The infection of humans with an H5 avian influenza virus in Hong Kong in 1997 has resulted in a reconsideration of the role of the avian species in the epidemiology of human influenza (Food and Agriculture Organization of the United Nations, 2007).

From the above it can be deduced that it is commonly accepted that migratory waterfowl, most conspicuously wild ducks, are the natural reservoir of avian influenza viruses, which can be transmitted to domestic bird populations and to commercial poultry. Direct or indirect contact between domestic flocks and wild migratory waterfowl has been implicated as a recurrent cause of epidemics in poultry populations. The next section describes the clinical presentation of the avian influenza virus.
3.9. **Clinical presentation of the avian influenza virus**

According to Nagpal (2006), the current strain of avian flu tends to infect young people and children who had previously been in good health. Avian flu in people causes a viral pneumonia that is potentially fatal, even before there is evidence of secondary bacterial infection.

The Food and Agriculture Organization of the United Nations (2007), states that the clinical signs are very variable and are influenced by factors such as the virulence of the infecting virus, species affected, age, sex, concurrent diseases and the environment. In the next section the clinical features in humans will be discussed.

3.9.1. **Clinical features in humans**

The clinical spectrum of influenza A (H5N1) in humans is based on descriptions of hospitalized patients. The frequencies of milder illnesses, subclinical infections, and atypical presentations (e.g., encephalopathy and gastroenteritis) have not been determined, but case reports indicate that each of these occurs. Most patients had been previously healthy young children or adults (Hien, et al., 2004, p.1179).

The incubation period of avian influenza A (H5N1) may be longer than for other known human influenzas. In 1997, most cases occurred within two to four days after exposure. Recent reports indicate similar intervals but with ranges of up to eight days. The case-to-case intervals in household clusters have generally been two to five days, but the upper limit has been eight to 17 days, possibly owing to unrecognized exposure to infected animals or environmental factors (Hien, et al., 2004, p.1179).

It therefore can be deduced that the clinical signs in humans are inconsistent and are influenced by factors such as the virulence of the infecting virus, species affected, age, sex, concurrent diseases and environmental factors.
The incubation period of the virus in humans is two to four days after exposure. Initial symptoms in humans are described next.

3.9.2. Initial symptoms in humans
Most patients have initial symptoms of high fever (typically a temperature of more than 38°C) and an influenza-like illness with lower respiratory tract symptoms. Upper respiratory tract symptoms are sometimes present. Unlike patients with infections caused by avian influenza A (H7) viruses, patients with avian influenza A (H5N1) rarely have conjunctivitis. Diarrhea, vomiting, abdominal pain, pleuritic pain, and bleeding from the nose and gums have also been reported early in the course of the illness in some patients. Watery diarrhea without blood or inflammatory changes appears to be more common than in influenza due to human viruses and may precede respiratory manifestations by up to one week (World Health Organization, 2004b, p.1).

It can thus be concluded that most avian influenza infected patients have initially high fever and influenza-like illness symptoms. The section below describes the case definition for avian influenza in humans.

3.9.3. Case definition for avian influenza in humans
The World Health Organization (2005b), points out that due to local conditions each country may have a different case definition for avian influenza in humans. In Chapter Four (see Section 4.3.1.) a case definition for avian influenza in humans is developed based on the case definition of the World Health Organization (2005b, p.3).

From the above it can be deduced that all countries will have their own case definitions for avian influenza and that they can use the World Health Organization’s definition as a template in developing theirs. In the next section clinical signs in animals will be discussed.
3.9.4. **Clinical signs of avian influenza in birds**

In virulent, or highly pathogenic avian influenza of the type traditionally associated with fowl plague, the disease appears suddenly in a flock and many birds die either without premonitory signs or with minimal signs of depression, inappetence, ruffled feathers and fever. Other birds show weakness and a staggering gait. Hens may at first lay soft-shelled eggs, but soon stop laying. Sick birds often sit or stand in a semi-comatose state with their heads touching the ground. Combs and wattles are cyanotic and oedematous, and may have petechial or ecchymotic haemorrhages at their tips. Profuse watery diarrhoea is frequently present and birds are excessively thirsty. Respiration may be laboured. Haemorrhages may occur on unfeathered areas of skin. The mortality rate varies from 50 to 100% (Food and Agriculture Organization of the United Nations, 2007).

In broilers, the signs of disease are frequently less obvious with severe depression, inappetence, and a marked increase in mortality being the first abnormalities observed. Oedema of the face and neck and neurological signs such as torticollis and ataxia may also be seen. The disease in turkeys is similar to that seen in layers, but it lasts two or three days longer and is occasionally accompanied by swollen sinuses. In domestic ducks and geese the signs of depression, inappetence and diarrhea are similar to those in layers, though frequently with swollen sinuses. Younger birds may exhibit neurological signs (Food and Agriculture Organization of the United Nations, 2007). The incubation period is usually three to seven days, depending upon the isolate; the dose of inoculum, the species, and the age of the bird (World Health Organization, 2006e). Discuss below are differential diagnosis in birds.

3.9.5. **Differential diagnosis in animals**

According to Harder & Werner (2006, p.1), the following diseases must be considered in the differential diagnosis of virulent avian influenza:

- Newcastle disease;
• infectious laryngotracheitis;
• duck plague;
• acute poisonings;
• other diseases causing swelling of the combs and wattles;
• acute fowl cholera and other septicaemic diseases; and
• bacterial cellulitis of the comb and wattles.

Less severe forms of the disease may be confused with, or complicated by many of the diseases with respiratory or enteric signs. Avian influenza should be suspected in any disease outbreak in poultry that persists, despite the application of preventive and therapeutic measures for other diseases (Food and Agriculture Organization of the United Nations, 2007). It can be concluded from the above that avian influenza must be suspected in any disease outbreak in poultry, despite the fact that there are other bird diseases with similar symptoms.

3.9.6. The pathology of avian influenza
According to the Food and Agriculture Organization of the United Nations (2007), birds that die of a peracute disease may show minimal gross lesions, consisting of dehydration and congestion of viscera and muscles. In birds that die after a prolonged clinical course, petechial and ecchymotic haemorrhages occur throughout the body, particularly in the larynx, trachea, proventriculus and epicardial fat, and on serosal surfaces adjacent to the sternum. There is extensive subcutaneous oedema, particularly around the head and hocks. The carcase may be dehydrated. Yellow or grey necrotic foci may be present in the spleen, liver, kidneys and lungs. The air sacs may contain an exudate and the spleen may be enlarged and haemorrhagic.

Avian influenza is characterised histologically by vascular disturbances leading to oedema, haemorrhages and perivascular cuffing, especially in the myocardium, spleen, lungs, brain and wattles. Necrotic foci are present in the lungs, liver and kidneys. Gliosis, vascular proliferation and neuronal
degeneration may be present in the brain (Food and Agriculture Organization of the United Nations, 2007). Transmission of avian influenza is discussed in the next section.

3.10. Transmission of avian influenza

Although the names avian influenza and bird flu conjure up images of an upper respiratory disease, in birds a large volume of virus is shed through the faeces. Infected faecal contamination of feed, water, equipment, clothing, boots, etc, is thus a common method of spreading the disease. Birds that survive infection excrete the virus for at least ten days, orally and in faeces, thus facilitating further spread at live poultry markets and by migratory birds (Nagpal, 2006). The following paragraphs discuss different modes of transmission.

3.10.1. Transmission of avian influenza between humans

Available evidence suggests that transmission of human influenza viruses occurs through multiple routes including large droplets by direct or indirect contact. Airborne (droplet nuclei) transmission may be more likely to occur in situations in which droplet nuclei particles are generated (i.e., aerosol-generating procedures in infected patients). Using current transmission-based terminology, influenza is transmitted between humans via droplets (droplet transmission), by direct and indirect contact (contact transmission), and small-particle aerosols (airborne transmission). The importance of each route of transmission, particularly in settings where there are adequate air changes per hour, remains unclear (World Health Organization, 2006a).

The World Health Organization (2006a) is of the opinion that although assessment of possible human-to-human transmission of avian influenza A (H5N1) is complicated by the likelihood that close contacts often have similar exposure histories (e.g., poultry exposures), available evidence indicates that limited human-to-human transmission avian influenza, including influenza A (H5N1), in humans may have occurred. Sustained transmission has not been
demonstrated and there is no evidence that there has been more than one generation of human-to-human transmission.

In the 1997 avian influenza A (H5N1) outbreak in Hong Kong, there was evidence of possible human-to-human transmission between infected persons and household contacts and health care workers, but social contact was not associated with avian influenza A (H5N1) infection. In the current avian influenza outbreak, investigation of human avian influenza A (H5N1) cases suggests that human-to-human transmission may have occurred in household clusters and in one case of apparent child to mother transmission. Thus far, all secondary cases appear to have had close contact with cases without the use of precautions and human-to-human transmission via the airborne route has not been identified (World Health Organization, 2006a).

Human conjunctivae and ciliated nasal epithelial cells contain cellular receptors that are preferentially recognized by avian, rather than human, influenza haemagglutinin. Therefore, the contribution of the possible routes of transmission in humans may differ between avian influenza A (H5N1) and seasonal human influenza. Although it is unknown at this time whether inoculation of the eye or nose will be important in the acquisition of human avian influenza A (H5N1) infection, it seems prudent to protect these sites from inoculation. Also, since diarrhoea has been frequently noted in avian influenza avian influenza A (H5N1) infected patients and avian influenza A (H5N1) has been isolated from the faeces of a human case, faeces may also prove to be a source of infection (World Health Organization, 2006a).

The World Health Organization (2006e) states that disease transmission and severity may also be related to viral load, viral strain, and host immune response. Although human-to-human transmission of avian influenza A (H5N1) has been rare to date, the accumulation of point mutations or reassortment with a human influenza virus could lead to increased
transmissibility of the virus at any time. Infections in health care workers could signal such a change.

From the above it can be construed that human-to-human transmission of avian influenza A (H5N1) has been infrequent to date. The accumulation of point mutations or reassortment with a human influenza virus could lead to increased transmissibility of the virus. Discussed below are the transmission of avian influenza from the environment to humans.

3.10.2. Transmission of avian influenza from birds to humans

According to the World Health Organization (2006a), the first human cases of avian influenza (H5N1) associated with the current outbreak in birds were confirmed in January 2004, after clinical samples taken from two children and one adult admitted to a hospital in Hanoi with severe respiratory illness tested positive for this strain. Since then, additional human cases have occurred in several countries. The clinical spectrum of avian influenza (H5N1) infections in humans ranges from asymptomatic to a severe disseminated disease.

Transmission of avian influenza viruses from birds to people remains relatively rare and in most cases occurs as a result of direct contact with infected poultry or other birds or their faeces. Faecal material can contaminate dust, soil, water, feed, equipment, clothing and feathers. Transmission to people only occurs with certain strains of avian influenza. According to the World Health Organization (2006a), there is evidence that the H5N1 strain of the bird flu virus - which has been circulating in birds - has a unique capacity to mutate and jump the species barrier causing a disease with high mortality in humans. The first priority, according to the World Health Organization, is to reduce opportunities for human exposure to the largest reservoir of the virus, viz, infected poultry. This is achieved through the rapid detection of poultry outbreaks and the emergency introduction of control measures, including the destruction of all infected or exposed poultry stock and the proper disposal of carcasses.
Normally, avian influenza viruses do not infect humans because of host barriers to infection, such as cell receptor specificities. However, they can occasionally cross the species barrier and directly infect humans, including highly pathogenic strains that have caused a fatal disease in humans (Webby & Webster, 2003). In 1997, avian influenza A (H5N1) caused an outbreak in domestic poultry in Hong Kong and also infected humans, hospitalizing 18 people and causing six deaths (Yuen, et al., 1998; Chan, 2004, p.2). Since then, other avian influenza outbreaks, e.g., H9N2 in 1999, H7N2 in 2002, and H7N7 in 2003, have resulted in human infections (Horimoto & Kawaoka, 2005). To date no cases of bird flu caused by the H5N1 strain have been reported in South Africa.

From the above it can be deduced that transmission of avian influenza viruses to people remains relatively uncommon and in most cases crop up as a result of direct contact with infected poultry or other birds or their faeces. In general, avian influenza viruses do not infect humans but occasionally transcend the species barrier and can infect humans.

3.10.3. Transmission of avian influenza from the environment to humans

Given the survival of influenza A (H5N1) in the environment, several modes of transmission are theoretically possible. Oral ingestion of contaminated water during swimming and direct intranasal or conjunctival inoculation during exposure to water are potential modes of transmission, as is contamination of hands from infected fomites and subsequent self-inoculation. The widespread use of untreated poultry faeces as fertilizer is another possible risk factor (Hien, et al., 2004, p.1179).

Apart from being highly contagious, avian influenza viruses are readily transmitted from farm to farm by mechanical means, such as by contaminated equipment, vehicles, feed, cages, or clothing. Highly pathogenic viruses can survive for long periods in the environment, especially when temperatures are
low. Stringent sanitary measures on farms can, however, confer some degree of protection (Pienaar & Horner, 2005, p.7).

From the above it can be concluded that that there are several possible modes of avian influenza transmission from the environment to humans. A further deduction is that the avian influenza virus can survive in various harsh environmental conditions. Below explained is the transmission in birds.

### 3.10.4. Transmission of avian influenza in birds

According to Nagpal (2006), birds that survive infection excrete the virus for at least ten days, orally and in faeces, thus facilitating further spread to live poultry markets and to migratory birds. Once avian influenza is established in domestic poultry, it is a highly contagious disease and wild birds are no longer an essential ingredient for its spread. Infected birds excrete the virus in high concentrations in their faeces and also in nasal and ocular discharges. Once introduced into a flock, the virus is spread from flock to flock by the usual methods involving the movement of infected birds, contaminated equipment, egg flats, feed trucks and service crews to mention a few. The disease generally spreads rapidly in a flock by direct contact, but on occasions spread is erratic.

Airborne transmission may occur if birds are in close proximity and with appropriate air movement. Birds are readily infected via instillation of the virus into the conjunctival sac, nares, or the trachea. Preliminary field and laboratory evidence indicates that the virus can be recovered from the yolk and albumen of eggs laid by hens at the height of the disease. The possibility of vertical transmission is unresolved; however, it is unlikely that infected embryos could survive and hatch. Attempts to hatch eggs in disease isolation cabinets from a broiler breeder flock at the height of the disease failed to result in any AI-infected chickens. This does not mean that broken contaminated eggs could not be the source of virus to infect chicks after they hatch in the same incubator. The hatching of eggs from a diseased flock
would probably be associated with considerable risk (Food and Agriculture Organization of the United Nations, 2007). Next discussed are the risk of spreading avian influenza in poultry and related industries.

3.10.5. **Risk of spreading the avian influenza in poultry and related industries**

According to Pienaar and Horner (2005, p.8), avian influenza could appear in more than one province within a short space of time because of the ease of spread and bird movement from a single initial introduction. The poultry industry is important for South Africa’s food security as it is a major supplier of animal protein and supplies many direct and indirect industries. It therefore becomes important to develop detailed work methods and - procedures for the surveillance and control of avian influenza within these industries.

According to Pienaar and Horner (2005), the South African poultry industry is broadly divided into four sectors, namely:

- A large commercial/industrial sector;
- a widely distributed small-commercial sector;
- a widely distributed village poultry population, backyard poultry and pet bird collections; and
- the ostrich industry.

Nagpal (2006, p.23) list the poultry and related industries that pose a high risk of avian influenza spread as follows:

- Primary and secondary breeder farms;
- Hatcheries;
- Broiler /grower farms;
- Layer farms;
- Pullet rearing farms;
- Non-commercial sector;
- Abattoirs;
• Further processing;
• Egg depots;
• Retail outlets;
• Feed industry;
• Pharmaceutical industry; and
• Poultry equipment, buildings, electronics, manufacturing and supply industries.

According to Nagpal (2006, p.23). The possible routes of the avian influenza virus entry into South Africa include the following activities.

• Importation of live birds (domestic or other);
• importation of poultry products;
• smuggling of birds or products;
• return of persons who have been in direct/indirect contact with infected chickens/premises overseas; and
• contact with wild birds especially waterfowl and waterbirds.

Pienaar and Horner (2005), state that it is important to recognise the danger of open dams/vleis near poultry premises which may be used by wild birds. Water from such areas could act as a source of the avian influenza virus. Poultry that have access from the said areas could in turn infect other poultry flocks.

From the above it can be concluded it is important to identify all possible risk areas that may increase the risk of spreading avian influenza in the country. The identification of the said risk areas can be used in the development of detailed work methods and - procedures for the surveillance and control of avian influenza. The next section discusses incidences of avian influenza.
3.11. Incidences of avian influenza
The avian influenza virus has a worldwide occurrence and may occur as a low (LPAI) or high (HPAI) pathogenic (virulent) strain (World Health Organization, 2006a). In the sections that follow the incidences of avian influenza will be discussed.

3.11.1. Avian influenza incidences in the world
The outbreak of highly pathogenic avian influenza A (H5N1), which began in Southeast Asia in mid-2003, is the largest and most severe on record. Never before in the recorded history of this disease have so many countries been simultaneously affected. The avian influenza A (H5N1) virus has also proved to be especially tenacious. Since January 2004 the World Health Organization has reported human cases of avian influenza A (H5N1) in Asia, Africa, the Pacific, Europe, and the Near East. Since December 2003, avian influenza A (H5N1) infections in animals have also been reported in Asia, Africa, the Pacific, Europe, and the Near East (World Health Organization, 2007c).

The avian influenza A (H5N1) epizootic (animal outbreak) in Asia and parts of Europe, the Near East, and Africa is not expected to diminish significantly in the short term. Despite the death or destruction of an estimated million birds, the virus is now considered endemic in many parts of Indonesia and Vietnam and in some parts of Cambodia, China, Thailand, and the Lao People’s Democratic Republic (World Health Organization, 2006e).

3.11.2. Epidemiological case investigations of human avian influenza
The paragraph below presents notable findings of epidemiologic investigations of human H5N1 cases (World Health Organization, 2006a):

- Thailand, 2004: An investigation concluded that probable human-to-human spread of influenza A (H5N1) had occurred in a family as a result of prolonged and very close contact between an ill child and her mother. Transmission did not continue beyond one person;
• Vietnam, 2004: While the majority of known human H5N1 cases have begun with respiratory symptoms, one atypical fatal case of encephalitis in a child in southern Vietnam was identified retrospectively as H5N1 influenza through testing of cerebrospinal fluid, faecal matter, and throat and serum samples. Further research is needed to ascertain the implications of such findings;

• Vietnam, 2005: Investigations suggest transmission of H5N1 viruses to at least two persons through consumption of uncooked duck blood;

• Azerbaijan, 2006: Investigations revealed contact with H5N1-infected wild dead birds (swans) as the most plausible source of infection in several cases in children. The children were involved in removing feathers from the birds; and

• Indonesia, 2006: The World Health Organization reported evidence of human-to-human spread. In this situation, eight people in one family were infected. The first family member is thought to have become ill through contact with infected poultry. This person then infected six family members. One of those six people (a child) then infected another family member (his father). No further spread outside of the exposed family was documented or suspected.

Confirmed instances of avian influenza viruses infecting humans since 1997 are listed in Annexure 12 (Center for Infectious Disease Research and Policy, 2006). In Annexure 13 and Annexure 14 respectively, affected areas with confirmed human cases of H5N1 avian influenza since 2003 and areas reporting confirmed occurrence of H5N1 avian influenza in poultry and wild birds since 2003, are illustrated (World Health Organization, 2006e). From the above maps it can be concluded that recent H5N1 avian influenza occurrence is not limited to Southeast Asia, but has now also affected birds and human in Europe and in Africa.
3.11.3. **Avian influenza incidences in South Africa**

To date, no cases of bird flu caused by the highly pathogenic avian influenza strain have been reported in South Africa. However, since the first isolation of the avian influenza strain H5N2, two recent infections of the H5N2 avian influenza virus were detected in South Africa (National Department of Health, 2005).

Firstly, in August 2004, H5N2 avian influenza virus was isolated on a farm in the Eastern Cape province and a second H5N2 outbreak was recorded during May 2006 in the Western Cape districts of Mossel Bay and Riversdale. Previously avian influenza viruses were found in ostriches in 1991, 1994 and 1995. LPAI (H6N2) was reported and confirmed for the first time in the commercial chicken industry in South Africa, following outbreaks of the disease in KwaZulu-Natal in 2002 and subsequently in Gauteng, the Free State, North-West, Mpumalanga and the Western Cape provinces (National Department of Health, 2005).

The expanding geographic distribution of avian influenza A (H5N1) infections indicates that more human populations are at risk. The risk of a pandemic will persist until the disease is controlled in birds, which may take several years (World Health Organization, 2006e).

3.12. **Risk assessment**

South Africa is classified by the World Health Organization as a low-risk country for an outbreak of highly pathogenic avian influenza. The risk of a pandemic is great and will persist, but the timing and severity are unknown. Risks need to be defined immediately. Various sectors that are more likely to be affected are encouraged to conduct studies on the expected impact of an avian influenza pandemic. Modelling studies on the impact of an avian influenza pandemic on varying attack rates should be done as well as systems for early detection, testing and reporting. Impact measures should include health facility attendance, admissions, and deaths. The social and
economic impact should also be assessed. An estimation of the effects of potential interventions with antiviral medication and/or vaccines in various groups should be computed (National Department of Health, 2006).

It is impossible to predict when the next pandemic of influenza will occur. It is almost 35 years since the last pandemic, and the longest interpandemic interval recorded with certainty is 39 years. The next pandemic virus is likely to emerge in South East Asia, as have two of the last three pandemic viruses. Complete global spread is likely to occur within six months or less, due to increased travel and urbanization. It is likely that the usual interpandemic pattern of age-specific mortality will deviate temporarily towards higher mortality in younger adults. The extent to which this will happen is unclear, as the shift was extreme in 1918-1919, but less so in subsequent pandemics. Nevertheless, this may have important implications for the protection of essential workers such as health care, emergency service and military personnel. The extent to which elderly persons will be affected will depend upon previous exposure to similar influenza viruses. It is impossible to predict the likely increase in excess mortality that will occur when a new pandemic virus emerges. Whilst mortality on the scale experienced in 1918-1919 is probably unlikely, there was a high level of mortality among those infected with the A/H5N1 virus in 1997. It therefore cannot be assumed that a future pandemic will be as mild as those that occurred during 1957-1958 and 1968-1969 (Nagpal, 2006).

According to the World Health Organization (2006a), the widespread persistence of H5N1 in bird populations poses two main risks to human health. The first is the risk of infection when the virus spreads directly from birds to humans. The second risk, which is of even greater concern, is that there will be increased possibilities for the widely circulating virus to infect humans and possibly reassort into a strain that is both highly infectious for humans that may spread easily from human-to-human. The accumulation of point mutations or reassortment with a human influenza virus could lead to
increased transmissibility of the virus at any time. Such a change could mark 
the start of a pandemic.

3.12.1. Estimated impact of a future influenza pandemic

If the morbidity and mortality of the past pandemics are the yardsticks for the 
future, then it is certain that with the modern day air travel and other 
modalities of transport the disease would spread fast between continents, 
countries, states and districts. There would be a simultaneous impact on all 
communities. High population densities would further augment it. The high 
strike rate would overwhelm existing health facilities. Limited availability of 
drugs and vaccines would accentuate the crisis situation. Sickness and 
absenteeism would impact on all sectors. Socio-economic disruption would 
ensue. Assistance from state and international agencies may not be available 
due to nation and world impact (Nagpal, 2006).

There is likely to be more than one wave of infection and health services in 
most countries would be hard-pressed to provide vaccines or to manage 
populations with clinical attack rates of approximately 25-30% and 
concomitant increases in demand for both primary and secondary health care 
services (Nagpal, 2006). Provincial health departments can calculate the best-
and worst case scenario of an avian influenza outbreak in a province (Nagpal, 
2006). The values are calculated from the United States preparedness plan 
that took the past pandemic figures as a yardstick. Other provinces can in a 
similar way calculate the different scenarios for their provinces that can assist 
in the preparation of an avian influenza pandemic preparedness plan. 
Provinces must keep in mind possible confounding factors in their respective 
provinces that could influence the calculated values. A best case scenario and 
worst case scenario of an avian influenza outbreak in the Eastern Cape 
Province are presented below (Eastern Cape Department of Health, 2001, 
p.22).
- **Best case scenario for the Eastern Cape province**
  - Population 6 436 763;
  - Attack rate (30-35%) = 1 931 028.90 to 2 252 867.05. Average attack rate = 2 091 947.98;
  - Out patients (at 6-15%) = 386 205.78 to 965 514.45. Average out patients = 675 860.12;
  - Hospitalization (at 0.1 to 0.25%) = 6 436.76 to 16 091.91. Average hospitalization = 11264.34; and
  - Deaths (at 0.03-0.07% of total patients) = 117.79 to 687.12.

- **Worst case scenario for the Eastern Cape province**
  - Population 6 436 763;
  - Attack rate 60-65% = 3 862 057 to 4 183 895.95. Average attack rate = 4 022 976.48;
  - Outpatients (at 15-30%) = 965 514.45 to 1 931 028.90. Average out patients = 1 448 271.68;
  - Hospitalization (at 5-10%) = 321 838.15 to 643 676.3. Average hospitalization = 482 757.23; and
  - Deaths (at 50-60% of hospitalized patients) = 160 919.08 to 386 205.8.

**3.12.1.1. Impact on the health care system and infrastructure**

The impact of a future influenza pandemic on the health care system will contribute to:

- extreme staff shortages;
- shortage of beds;
- shortage of key supplies (ventilators, drugs);
- hospital morgues, health care workers and mortuary services will be overwhelmed; and
- extreme demands on social and counselling services (Nagpal, 2006).
The impact of a future influenza pandemic on infrastructure will contribute to significant disruption of transportation, commerce, utilities, public safety and communications (Nagpal, 2006).

### 3.12.1.2. Impact on businesses

The impact of a future influenza pandemic on businesses will contribute to:

- high absenteeism;
- challenges getting to/from worksites;
- psychological impacts on the workforce will be extreme;
- social distancing efforts may dramatically change hours of operation or close businesses temporarily; and
- economic losses – small businesses are at greatest risk (Nagpal, 2006).

From the above it can be deduced that a future influenza pandemic will be devastating on businesses and contribute to enormous economic losses.

### 3.12.1.3. Impact of an outbreak of highly pathogenic avian influenza

Pienaar and Horner (2005) give a similar list for the impact of an outbreak of highly pathogenic avian influenza on poultry production within the Republic of South Africa. A highly pathogenic avian influenza outbreak will have a direct effect on:

- trade;
- export;
- allied industries;
- employment;
- food security;
- movement of live poultry and poultry products;
- media reaction;
- public reaction/fears; and
• public health implications.

From the findings above it can be concluded that the impact of an outbreak of highly pathogenic avian influenza will have devastating consequences on the various parts of the industry, the village chicken farmer, the country and also for the Southern African region.

3.12.2. Mitigation of the impact of highly pathogenic avian influenza

In order to mitigate the risk and for international planning purposes, the World Health Organization (2006e) has defined six phases in the progression of an influenza pandemic from the first emergence of a new influenza virus to the wide international spread (see Annexure 15). These phases allow a stepwise escalating approach to preparedness planning and response. The Director-General of the World Health Organization has designated a global pandemic alert: Phase Three as of 16 March 2006. South Africa is designated as “not affected”, but is still required to implement measures for Phase Three.

The World Health Organization has recommended that each country set overarching goals, objectives and specific activities for each of the new pandemic phases. The objectives and actions are divided into the following five categories: (i) planning and coordination; (ii) situation monitoring and assessment; (iii) prevention and containment (non-pharmaceutical public health interventions, vaccines and antivirals); (iv) health system response; and (v) communications. The mentioned mitigating aspects will be discussed in the following two chapters. From the discussions above it can be concluded that a well coordinated strategy for preparedness is required at provincial and health district level for a robust response to mitigate the impact of a pandemic.

3.13 Conclusion

Influenza is an infectious respiratory illness associated with infection by the influenza virus of the virus family Orthomyxoviridae. The severity of the illness can range from gentle to lethal. It is an illness that can be present in humans
and in animals. Symptoms normally comprise headaches, aching muscles and joints, malaise, fever, chills, cough, sore throat, and prostration.

The influenza virus is genetically extremely changeable. It is this changeable nature of the virus that results into regular alterations in the antigenicity of the virus. The constant genetic changes within the virus contribute to new strains of the virus ensuing in recurring outbreaks or epidemics.

The influenza virus can be categorized into three types. The three types are Type A, Type B and Type C of which Type A is the most dangerous. The three different classifications of the virus are based on the antigenicity of the nucleoproteins which envelop the RNA genome of the virus. Influenza Type A viruses can be separated into two subtypes, hemagglutinin (HA) and neuraminidase (NA). There are sixteen identified HA subtypes and nine NA subtypes. The HA and NA surface proteins can form a number of probable permutations.

There are fundamentally two ways in which the influenza virus can alter its antigenicity, namely antigenic shift and antigenic drift. Antigenic shift is characterized by sudden and major modifications in antigenicity that gives rise to a totally new subtype of virus. Antigenic shift is happening about once every 10-40 years and can cause dramatic and unexpected pandemics. Antigenic drift represents slow but progressive changes in antigenicity which can spread throughout the human population, causing widespread epidemic activity - approximately every three to five years.

Avian influenza, or bird flu, is a highly contagious viral disease of animals. All types of birds are susceptible to the virus but outbreaks occur most often in chickens and turkeys. Type A viruses can cause infection in man, pigs, equines, birds and marine mammals. Avian influenza can be separated into Low Pathogenic Avian Influenza and Highly Pathogenic Avian Influenza. Avian influenza infections in poultry are caused by the H5 and H7 subtypes of
the influenza A virus. Low Pathogenic Avian Influenza, (forms H5 and H7 subtypes) have been identified in poultry in South Africa, but as the name implies, it does not cause major mortality problems. Currently no Highly Pathogenic Avian Influenza strain has been reported in South Africa.

There are conspicuous difference between human seasonal influenza, avian influenza and human pandemic influenza. Human Seasonal influenza viruses cause outbreaks of influenza every winter season. These outbreaks generally distress between 2-30% of the population ensuing unpredictable levels of morbidity and mortality. This form of influenza is mostly confined to elderly individuals, especially those with underlying medical conditions. Avian influenza, or bird flu, is caused by different influenza virus strains that normally infect various species of birds. Although avian influenza viruses are generally extremely species-specific and therefore are of concern primarily to poultry farmers and veterinary authorities, they have on relatively infrequent instances transcended the species barrier to infect humans. An influenza pandemic (global epidemic) occurs when a new influenza virus subtype emerges that has not previously circulated in humans.

Domestic fowl, ducks, geese, turkeys, guinea fowl, quail and pheasants are considered as natural hosts of the avian influenza virus. Ducks have been identified as the bird specie with the highest prevalence for the influenza A virus. It is generally established that migratory waterfowl, most conspicuously wild ducks, are the natural reservoir of avian influenza viruses. Epidemics in the poultry populations are frequently caused by direct or indirect contact between domestic flocks and wild migratory waterfowl.

The clinical signs of avian influenza are inconsistent and are influenced by features such as the virulence of the infecting virus, species affected, age, sex, concurrent diseases and environment. The incubation period of the virus in humans is two to four days after exposure. The initial symptoms of the majority of patients are characterized by high fever (typically a temperature of
more than 38°C) and an influenza-like illness with lower respiratory tract symptoms. All countries must develop their own case definitions. Countries can use the case definition of the World Health Organization as a template in developing theirs.

In virulent (or highly pathogenic) avian influenza of the type conventionally linked to fowl plague, the disease appears swiftly in a flock and many birds die either without premonitory signs or with minimal signs of depression, inappetence, ruffled feathers and fever. In broilers, the signs of disease are often less noticeable with severe depression, inappetence and a striking increase in mortality being the first abnormalities observed. The incubation period of the disease in birds is normally three to seven days. The incubation period can be influenced by factors such as the type of specie, the type of isolate, the dose of inoculum, and age of the bird. Mortality amongst birds are histologically characterized by vascular disturbances leading to oedema, haemorrhages and perivascular cuffing, especially in the myocardium, spleen, lungs, brain and wattles. Necrotic foci are present in the lungs, liver and kidneys.

To date the transmission of avian influenza viruses to people remains fairly sporadic. Most reported cases occur as a result of direct contact with infected poultry or other birds or their faeces. Generally, avian influenza viruses do not infect humans because of host barriers to infection, such as cell receptor specificities. However, they can occasionally cross the species barrier and directly infect humans. It has been established that the H5N1 strain - which has been circulating in birds - has the potential to mutate and transcends the species barrier causing a disease with eminent mortality in humans. Environment to human transmission of the virus can occur through several modes including self-inoculation by contact with contaminated equipment, vehicles, feed, cages, clothing or contaminated water.
Birds that survive infection excrete the virus for at least 10 days, orally and in faeces, thus facilitating further spread at live poultry markets and by migratory birds. Once avian influenza is established in domestic poultry, it is a highly contagious disease and wild birds are no longer essential for the spread. The disease generally spreads rapidly in a flock by direct contact, but on occasions spread is erratic. Direct contact can come from contaminated equipment, egg flats, feed trucks, and service crews. Airborne transmission may occur if birds are in close proximity and with appropriate air movement.

The risk of spreading of the disease is increase by direct spread through contact with live birds, infected premises, infected products, contaminated equipment, or by the movement offsite of personnel, vehicles, etc. The virus can survive in/on carcasses, feathers, meat, on eggs, offal, faeces and litter. Live bird markets/sales are an important potential source for the rapid spreading of epidemic diseases. The poultry industry is important for South Africa’s food security as it is the major supplier of animal protein and supplies many direct and indirect industries. Therefore it becomes important to identify the sectors within the poultry and related industry in order to develop detailed work methods and - procedures for the surveillance and control of avian influenza.

Avian influenza is gradually becoming a worldwide occurrence with the (H5N1) strain proved to be particularly tenacious. The avian influenza A (H5N1) animal outbreak in Asia and parts of Europe, the Near East, and Africa is not expected to diminish significantly in the short term. The increasing geographic distribution of avian influenza A (H5N1) infections signify that more human populations are at risk. The widespread persistence of H5N1 in bird populations poses two main risks to human health. The first is the risk of infection when the virus spreads directly from birds to humans. The second risk is that there will be increased possibilities for the widely circulating virus to infect humans and possibly reassort into a strain that is both highly infectious for humans that may spread easily from humans-to-humans.
An outbreak of highly pathogenic avian influenza will have devastating consequences on various parts of the poultry industry, the village chicken farmer, the country and also for the Southern African region. There would be simultaneous impact on all communities. The high strike rate would overwhelm health facilities. Socio-economic disruption would ensue. Therefore, a well coordinated strategy for preparedness is required at provincial and district level for a robust response and to mitigate the pandemic impact. The next chapter will discuss the work methods and procedures for the surveillance of avian influenza in the Eastern Cape province, South Africa.
CHAPTER FOUR

WORK METHODS AND PROCEDURES FOR THE SURVEILLANCE OF AVIAN INFLUENZA

4.1. Introduction

Avian influenza, which is caused by the A (H5N1) influenza subtype in animal populations, continues to pose a global public health risk. The virus has expanded its geographical range and therefore increasing the size of the populations at risk. The ability to control an infectious disease like avian influenza requires an effective and comprehensive public health surveillance system.

In this chapter, work methods and procedures for avian influenza surveillance are presented and discussed. Firstly, since avian influenza surveillance is a component of public health surveillance, the basic principles of avian influenza surveillance are explained from a public health surveillance perspective.

Secondly, work methods and procedures for human case surveillance are discussed in terms of case detection, reporting of the disease, the investigation of an avian influenza outbreak and case confirmation. Thirdly, work methods and procedures for bird surveillance (poultry and wild birds in general) are discussed. The said work methods and procedures are discussed in terms of early detection of avian influenza amongst birds, as well as clinical, serological and virological surveillance. The basic principles of human avian influenza surveillance are firstly presented below.

4.2. Basic principles of human avian influenza surveillance

According to Nagpal (2006, p.11), public health surveillance includes the process of disease detection through a standardized information collection system, the analysis and interpretation of the data, the dissemination of
information to the individuals who can act on it, and the facilitation of the necessary response that will effectively deal with the problem. The system should be structured in such a way that it can efficiently deal with routine health threats as well as epidemics. Whatever the public health problem, the surveillance and response capability must be built on a foundation of skills in areas such as case detection, epidemiology of the disease, data gathering, data analysis and interpretation, laboratory diagnostic confirmation and the application of an appropriate response.

Public health surveillance can also be described as the systematic collection of data pertaining to the occurrence of specific diseases, the analysis and interpretation of the data, and the dissemination of consolidated and processed information to contributors to the programme and other interested persons (Alfred, Evans, Richard, and Kaslow, 1997, p.89).

Thacker (1996, p.11), in a similar way as Alfred, et al. (1997, p.89), describes surveillance as the process of systematic collection, orderly consolidation and evaluation of pertinent data with prompt dissemination of the results to those who need to know. The prompt dissemination of the said data is particularly critical for those who are in a position to take action. The World Health Organization (2006c, p.18) lists the core components during the surveillance of any health event as:

- Case detection;
- case confirmation;
- case registration;
- reporting;
- data analysis and interpretation;
- epidemic preparedness;
- response and control; and
- feedback.
According to Alfred, et al. (1997, p.101), the general elements to consider during the development of a surveillance system are:

- Mortality registration;
- morbidity reporting;
- epidemic reporting;
- laboratory investigation;
- individual case investigation;
- epidemic field investigation;
- survey of human cases;
- animal reservoir and vector distribution studies;
- biologics and drug utilization; and
- knowledge of the population and environment.

Epidemic disease surveillances can be classified according to the method of reporting, the criteria for initiating the report, the location or population studied, and the purpose of the system (Alfred, et al., 1997, p.91). Generally surveillance is classified as passive surveillance or active surveillance. These are described below.

- **Passive surveillance** is the most common method of surveillance. Passive surveillance is defined by the World Health Organisation (1999b, p.152) as reports that are awaited, and no active attempt is made to seek reports from participants. The reporter, usually a physician or health officials of clinics and hospitals, transmits a weekly summary of all the cases of notifiable diseases they have identified the previous week. Pre-formatted reporting instruments are usually provided with a list of notifiable conditions, as defined by the relevant health authority. The reporting instruments are then sent in at periodic intervals to the public health office designated. The reporter gives data on the number of cases seen in the interval prescribed. Reporting can be accomplished by electronic mail, by
telephone (using toll-free numbers) and automatic recording devices that are available at all hours (Alfred, et al., 1997, p.91).

- **Active surveillance** means that the health authority conducting the surveillance initiates the procedures to obtain reports on a regular basis (usually weekly), rather than waiting for the reports, such as telephone calls or personal visits by the reporting individuals (Jekel, Elmore & Katz, 1996, p.37).

The gathering of surveillance data for avian influenza activities requires a combination of both active and passive surveillance. The surveillance data collected can be used for immediate public health action, programme planning and evaluation and the formulation of research hypotheses (Centre for Disease Control and Prevention, 2001, Section 4). It can therefore be deduced that the surveillance data are crucial in any surveillance system. In order to develop an effective avian influenza surveillance system, real-time and up-to-date information will be required. Avian influenza data can be collected by means of the surveillance strategies that deal with (United States of America Department of Health, 2006):

- Human case surveillance; and
- Bird surveillance.

In the following sections, the above-mentioned strategies will be discussed. Firstly discussed is human case surveillance.

### 4.3. Human case surveillance

For the purpose of this study, human avian influenza surveillance is divided into the following activities:

- Case detection;
- Reporting of a notifiable disease;
- Investigation; and
• Confirmation

The section below identifies and discusses the work methods and procedures for case detection of human avian influenza.

4.3.1. Case detection

Case detection is the process of identifying positive human cases or outbreaks. Case detection can take place through the formal health system, private health system or community structures. Up-to-date case definitions, appropriate alert and epidemic threshold values and a functioning rumour verification system are all vital elements for case and outbreak detection (World Health Organisation, 2006c, p.18).

According to Teutsch and Thacker (1995, p.6), an effective public health surveillance system is dependent on a clear case definition for the health-related event under surveillance. The case definition of a health-related event can include clinical manifestations (i.e., symptoms), laboratory results, epidemiological information (e.g., person, place, and time), and/or specified behaviours, as well as levels of certainty (e.g., confirmed/definite, probable/presumptive, or possible/suspected). The use of a standard case definition increases the specificity of reporting and improves the comparability of the health-related event reported from different sources of data, including geographic areas. The case definition of human avian influenza is discussed below.

• Case definition of avian influenza in humans

The case definitions in Figure One below applies to phase three of pandemic influenza. Phase three of pandemic influenza represents the global pandemic alert period during which little evidence exist of human to human transmission of avian influenza. Phase three refers to a new influenza virus subtype that is causing disease in humans, but is not yet spreading efficiently and sustainably among humans. The phase three classification may change as new
information about the disease or its epidemiology becomes available (World Health Organization, 2004a, p.3).

<table>
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<th>FIGURE 1</th>
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<td>CASE DEFINITION OF AVIAN INFLUENZA IN HUMANS</td>
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1. **Suspected cases** include patients with the following symptoms:
   - Fever (body temperature of 38 degrees Celsius or higher); in addition to:
   - One or more of the following symptoms – muscle ache, cough, abnormal breathing (unusual breathing difficulty), or suspicion of pneumonia by a physician, or influenza; in addition to:
     History of direct contact with infected / dead birds in the past 7 days, or occurrence of unusual death of birds in the community within the past 14 days; or contact with a pneumonia patient or another patient suspected of avian influenza.

2. **Probable cases**, which include the above-mentioned symptoms of suspected cases, in addition to:
   - Preliminary test shows infection of influenza group A, but cannot yet be confirmed whether it is influenza from humans or birds;
   - Respiratory failure; and
   - Death.

3. **A confirmed case** of influenza A/H5 infection is an individual, alive or deceased, in whom laboratory testing demonstrates one or more of the following:
   - a positive viral culture for influenza A/H5;
   - a positive polymerase chain reaction (PCR) for influenza A/H5;
   - a positive immunofluorescence antibody (IFA) test for H5 antigen using H5 monoclonal antibodies; and
   - a 4-fold rise in H5-specific antibody titre in paired serum samples.

Note: Diagnosis of suspected and probable cases can be changed if
confirmation tests show that the patient’s infection was caused by other factors.

Source: Modified from World Health Organisation (2005b, p.3) and confirmed by the Provincial Communicable Control Co-ordinators (group of experts) on 31 August 2008.

Health workers making a diagnosis must be familiar with the case definitions and with the clinical features of human avian influenza as listed in Annexure 16. Detailed contact and travel histories and knowledge of viral activity in poultry are essential for appropriate clinical case detection. Updated information on countries with recent avian influenza cases can be found at the following website: www.who.int/csr/disease/avianflu/en/ and http://www.oie.net/eng/en/pub/index.htm.

Suspected avian influenza cases can be detected by the active screening process (see Annexure 17). This screening method, also known as a febrile respiratory illness screener survey, provides screening questions to be asked of patients as part of an active screening process that can be done telephonically or at health establishments and can serve as an initial detection for avian influenza human cases. According to Nagpal (2006), a surveillance strategy for human cases of avian influenza requires close monitoring of all possible entrance points. This can include the monitoring of incoming travellers from infected regions, countries or localities in the country, state, province or locality, arriving by all means of transport.

For avian influenza, a single suspected case is the trigger for taking action, reporting the case to a higher level, and conducting an investigation. This is confirmed by the World Health Organization (2005c, p.8) who states that the alert threshold value for human avian influenza is one. An alert threshold suggests to health staff that further investigation is needed. It therefore means that all cases that meet the criteria outlined in Figure One above should immediately be reported to the local health authority. Work methods and -
procedures to be followed during the notifiable disease reporting processes are presented in the next section.

4.3.2. Reporting of a notifiable disease

Reporting of a notifiable disease refers to the process by which surveillance data move through the surveillance system from the point of generation. It also refers to the process of reporting suspected and confirmed outbreaks. Different reporting systems may be in existence depending on the type of data and the information being reported, the purpose and urgency of relaying the information and where the data/information is being reported (World Health Organization, 2006c).

A notification can serve as the first step in a surveillance cycle, namely data capturing or data collection. Government health agencies have the authority to designate that certain diseases are notifiable by law and their occurrence must be reported (Buehler, 1998, p.449). Notification of communicable diseases is governed both by country laws and International Health Regulations. According to the International Health Regulations, 2005, countries are obligated to report any occurrence of diseases of a sensitive nature to the World Health Organization (National Department of Health, 2006).

As in the majority of countries worldwide, South Africa has a routine notification system for reporting notifiable medical conditions. The primary purposes of the reporting system are disease control and the monitoring of disease trends in South Africa. The current disease notification system is based on the Health Act, 1977 (Act 63 of 1977), coupled with regulations on the reporting of specific diseases to local, provincial and national health departments. The International Health Regulations, 2005, govern a broad range of public health emergencies of international concern. It also includes emerging diseases such as avian influenza that upon confirmation must be
reported through the National Department of Health to the World Health Organization (World Health Organization, 2006c).

In South Africa, notification can be done via electronic mail, fax or telephone to the local authority concerned. Any person (not necessarily a health worker) can notify a medical condition. The formal work - procedures for avian influenza notification are illustrated in Figure Two below.

**FIGURE 2**

**WORK PROCEDURES TO REPORT HUMAN AVIAN INFLUENZA CASES**

**Diagnosis:** Can be any health worker, not necessarily a doctor

- Fill in form GW 17/5 (initial diagnosis form) and report immediately to the relevant:
  - Local authority / Hospital / Health District responsible for disease containment
    - Fill in form GW7/3 (cases)
    - Fill in form GW 17/4 (deaths)
    - and report immediately to the relevant:
      - Health District Surveillance Office
        - Health Information Unit if data entry is done at provincial level
          - Send data immediately on computer disks or by electronic-mail to the relevant:
            - Provincial Disease Surveillance Office
              - Health Information Unit if data entry is done at provincial level
                - (Send data on computer disks or by electronic-mail)
                  - Report immediately to:
                    - National Department of Health
                      - Directorate: Communicable Disease Control
Send data on computer disks or by electronic-mail
Report within 24 hours to:

World Health Organisation
Prevention and Control of Diseases Unit

Source: Modified from the National Department of Health (2003, pp. 344-347) and confirmed the Provincial Communicable Control Co-ordinators (group of experts) on 31 August 2008.

Reports of avian influenza cases should be standardized so that, whenever possible, the same information is recorded for each case (World Health Organisation Regional Office for Africa, 2001, pp. 56-57). A disease reporting form should provide important information of the reporting process. The currently used initial diagnosis form (i.e. form GW 17/5) for notifiable disease reporting is attached as Annexure 18. The initial diagnosis form mentioned above does not include a clear case definition or details of epidemiological and environmental investigation. From a human avian influenza surveillance perspective, a notifiable disease reporting form is presented in Annexure 19 which was accepted by the Provincial Communicable Control Co-ordinators (group of experts) on 31 August 2008. The following section discusses the investigation of an avian influenza outbreak.

4.3.3. Investigation of an avian influenza outbreak
According to the World Health Organisation Regional Office for Africa (2001, p.97), an investigation is a method used for identifying and evaluating people who have been exposed to an infectious disease or affected by an unusual health event. The investigation of a disease outbreak is a primary function of public health authorities.

The objectives for investigations of human cases of A(H5N1) is essentially, to firstly confirm the diagnosis of recent infection with influenza A(H5N1) in an
attempt to reduce morbidity and mortality through rapid identification, isolation, treatment and clinical management of cases and subsequent follow-up of contacts (World Health Organization, 2007b). Secondly, to ensure timely exchange of information among clinicians, investigators of public and animal health, and government officials to facilitate critical and informed decision-making at sub-district, district, provincial, national and international levels during the investigation.

Clinicians and public health officials at all levels need to be alerted to the detection of possible human cases of A (H5N1) infection. Once an avian influenza outbreak has been detected, routine or passive surveillance should be replaced by active surveillance (Giesecke, 2002, p.151). This implies that the investigation of the outbreak must be carried out immediately.

Tyler (1996, p.14) states that an epidemiological investigation is often triggered by effective epidemiological surveillance at various levels of reporting. From an avian influenza surveillance perspective, one or more suspected avian flu cases require an immediate outbreak investigation. Detection of possible human case(s) of A (H5N1) should trigger immediate notification of local, sub-national and national public health authorities to make immediate decisions about the launching of an investigation.

A number of critical activities must be undertaken as part of every A (H5N1) investigation. The detailed steps to be followed during every A (H5N1) investigation are described in a document entitled: Guidelines for investigation of human cases of avian influenza A (H5N1) (World Health Organization, 2007b). The key steps during the investigation of human cases of avian influenza A (H5N1) are indicated in Figure Three below:
Next presented are work methods and procedures for human case confirmation.

**4.3.4. Human case confirmation**

Case/outbreak confirmation refers to the epidemiological and laboratory capacity for confirmation. Capacity for case confirmation is enhanced through improved referral systems, networking and partnerships. This means having the capacity for appropriate specimen collection, packaging and transportation (World Health Organization, 2006a).

The appropriate collection of specimens is essential for the successful identification of viruses in clinical samples. There are several variables that
can contribute to the successful isolation and/or identification of a viral pathogen. Some of these variables include:

- The source of the specimen;
- the timing of collection of specimen in relation to the onset of the symptoms;
- the rapidity and method of specimen delivery to the laboratory; and
- specimen data provided to the laboratory (Alfred and Evens, p. 61).

According to the World Health Organization (2004b), the success of virus diagnosis largely depends on the quality of the specimen and the conditions for transport and storage of the specimen before it is processed in the laboratory. Work methods and procedures for specimen collection of suspected human avian influenza cases are presented in Annexure 20. The equipment that will be required by surveillance personnel in collecting human specimens is listed in Annexure 21. In collecting a specimen it is important for surveillance and control personnel to adhere to the infection precautions in Annexure 22 and to monitor their health for five days to detect early infection after contact with a suspected patient. The Influenza Illness Monitoring Form in Annexure 23 can be used for this purpose.

An avian influenza outbreak should be concluded by an investigation report. The investigation report should explain why the outbreak occurred and identify weaknesses in existing surveillance and control measures. This will enable recommendations to be made on specific prevention and control strategies (Katzenellenbogen, Joubert & Karim, 1997, p.203). When an outbreak of avian flue occurs, all efforts and resources should be aimed at controlling the outbreak. The process of an avian outbreak investigation should be conducted parallel with avian influenza control strategies. The next section discusses basic elements of avian influenza surveillance in birds.
4.4. Basic elements of avian influenza surveillance in birds

As discussed in Chapter Three, avian influenza is a highly contagious viral disease of domestic poultry and many species of wild birds caused by infection with a Type A influenza virus. Type A viruses can cause infection in man that could appear in more than one geographical area within a very short space of time because of the ease of spreading and bird movement from a single initial introduction. The ability to efficiently control the spread of a highly infectious, exotic disease such as highly pathogenic H5N1 avian influenza is dependent upon the capacity to rapidly detect the pathogen if introduced (Food and Agriculture Organization of the United Nations, 2006b).

According to the United States Department of Agriculture (2007, p.14), the key to successful avian influenza surveillance in birds should involve the following strategies:

- Early detection of morbidity and mortality;
- rapid reporting and submission of appropriate biological specimens to qualified diagnostic facilities;
- immediate assessment of the field event (descriptive epidemiology);
- rapid, accurate, and consistent diagnosis and confirmation;
- immediate reporting of diagnostic results, once confirmed; and
- pre-planned contingency and response training for the occurrence of highly pathogenic avian influenza.

The surveillance plan for avian influenza in birds should be in the form of a continuing programme which should focus on the following two elements (Food and Agriculture Organization of the United Nations, 2006b):

- Firstly, an early warning system for reporting suspicious cases, and
- secondly, the implementation of relevant, regular and frequent clinical inspection, serological and virological testing of high-risk groups of animals, such places where birds and poultry of different origins are mixed,
such as live bird markets, poultry in close proximity to waterfowl or other sources of possible avian influenza.

As mentioned earlier in Section 3.7., the natural hosts of the avian influenza virus include domestic fowl, ducks, geese, turkeys, guinea fowl, quail, pheasants, and other species of wild birds. For the purpose of this study the surveillance of birds will focus on poultry and wild birds in general and is explained below.

The World Health Organisation for Animal Health (2007b, p.26), defines poultry as all birds reared or kept in captivity for the production of meat or eggs for consumption, for the production of other commercial products, for restocking supplies of game, or for breeding these categories of birds. Similarly in South Africa the Animal Diseases Act, 1984 (Act 35 of 1984) defines “poultry” as pigeons, ducks, geese, fowl, turkeys, cage birds, muscovies, domesticated ostriches, tamed wild birds and wild birds kept in captivity.

Wild birds, by their very nature, are not subject to disease containment controls as are domestic birds and people. While their movements are generally uncontrollable, their movements are largely predictable on both a daily and seasonal basis. Local movements within or between breeding, feeding, and roosting areas should be monitored and documented by the state and local wildlife management authorities and others familiar with local bird populations. The movement of wild birds poses thus a particular problem to avian influenza surveillance personnel and requires an understanding of bird ecology and the meticulous mapping of daily and seasonal bird movements (World Organisation for Animal Health, 2007b).

Avian influenza surveillance strategies for birds are discussed under the following sections below:
• Early detection of disease;
• Clinical surveillance of birds;
• Serological surveillance of birds; and
• Virological surveillance of birds.

4.4.1. Early detection of disease

According to Pienaar and Horner (2005, p.46), early detection, reporting and diagnosis of the disease, together with the swift imposition of effective eradication and movement controls are essential in an attempt to contain an outbreak. An early detection system enables rapid detection of the introduction of, or sudden increase in the incidence of any disease of livestock which has the potential of developing to epidemic proportions and/or causing serious socio-economic consequences or public health concern. Early detection embraces all initiatives, mainly based on disease surveillance, reporting and epidemiological analysis that would lead to improved awareness and knowledge of the distribution and behaviour of disease outbreaks (and of infection) and which allow forecasting of the source and evolution of the disease outbreaks and the monitoring of the effectiveness of disease control campaigns (World Health Organisation, 2005, p.18).

According to the World Organisation for Animal Health, (2007a, p.33) avian influenza surveillance should include active and passive surveillance and both should be ongoing. The target population for surveillance aimed at the identification of the disease and infection should cover all the susceptible poultry species within a country. The frequency of active surveillance should be at least every six months. Surveillance should be composed of random and targeted approaches using virological, serological and clinical methods. These methods are discussed below.

4.4.2 Clinical surveillance of birds

Clinical surveillance aims at the detection of clinical signs of avian influenza at the flock level. Whereas significant emphasis is placed on the diagnostic value
of mass serological screening, surveillance based on clinical inspection should not be underrated. It may, for example, be appropriate to target clinical surveillance at particular species likely to exhibit clear clinical signs (e.g. chickens). Similarly, virological and serological testing could be targeted to species that may not show clinical signs (e.g. ducks) (Pienaar & Horner, 2005, p.46).

• **Clinical signs of avian influenza in birds.**
Monitoring of production parameters, such as increased mortality, reduced feed and water consumption, presence of clinical signs of a respiratory disease or a drop in egg production is important for the early detection of avian influenza infection in birds. In some cases of poultry species the only indication of avian influenza infection may be a drop in feed consumption or egg production (World Organisation for Animal Health, 2007a).

As discussed in Chapter Three (see Section 3.9.4.) bird flue can appear suddenly in a flock and many birds can die either without pre-monitory signs or with minimal signs of depression, inappetence, ruffled feathers and fever. Other birds show weakness and a staggering gait. Hens may at first lay soft-shelled eggs, but soon stop laying. Sick birds often sit or stand in a semicomatose state with their heads touching the ground. Combs and wattles are cyanotic and oedematous, and may have petechial or ecchymotic haemorrhages at their tips. Profuse watery diarrhoea is frequently present and birds are excessively thirsty. Respiration may be laboured and haemorrhages may occur on unfeathered areas of the skin. The mortality rate varies from 50 to 100% (Food and Agriculture Organization of the United Nations, 2007).

In broilers, the signs of the disease are frequently less obvious with severe depression, inappetence, and a marked increase in mortality being the first abnormalities observed. Oedema of the face and neck and neurological signs such as torticollis and ataxia may also be seen. The disease in turkeys is similar to that seen in layers, but it lasts two or three days longer and is
occasionally accompanied by swollen sinuses. In domestic ducks and geese, the signs of depression, inappetence, and diarrhea are similar to those in layers, though frequently with swollen sinuses. Younger birds may exhibit neurological signs (Food and Agriculture Organization of the United Nations, 2007). The incubation period is usually three to seven days, depending upon the isolate, the dose of inoculum, the species, and the age of the birds (World Health Organization, 2006a).

Clinical surveillance and laboratory testing should always be applied in series to clarify the status of avian influenza suspects. Laboratory testing may confirm clinical suspicion, while clinical surveillance may contribute to confirmation of positive serology. Any sampling unit within which suspicious animals are detected should be classified as infected until evidence to the contrary is produced. The identification of suspect flocks is also vital to the identification of sources of avian influenza and to enable the molecular, antigenic and other biological characteristics of the virus to be determined (World Health Organization, 2006e). All suspected cases based on the clinical features above must be immediately reported to the local authorities in order to mount an investigation. Work methods and procedures for specimen collection during clinical surveillance of birds are presented in Annexure 24. The section below discusses serological surveillance of birds.

### 4.4.3 Serological surveillance of birds

According to Alfred, et al. (1997, p.101), serological surveillance can be defined as the systematic collection and testing of blood samples from a target population or a representative sample thereof to identify current and past infectious diseases by means of antigen and antibody tests. An effective surveillance system for birds will periodically identify suspicious cases of avian influenza that require follow up and investigation to confirm or exclude the cause of an avian influenza infection.
Serological surveillance of birds is aimed at the detection of antibodies against highly pathogenic avian influenza. Positive avian influenza antibody test results can have four possible causes (World Organisation for Animal Health, 2007a, p.37) namely:

- Natural infection with avian influenza;
- vaccination against avian influenza;
- maternal antibodies derived from a vaccinated or infected parent flock are usually found in the yolk and can persist in progeny for up to 4 weeks; and
- positive results due to the lack of specificity of the test.

Serological surveillance methods can be targeted at random. Positive serological results should always be followed up with virological methods (Pienaar & Horner, 2005, p.48). The frequency of sampling should be dependent on the epidemiological situation. The criteria for random surveillance should be decentralized, i.e., to be decided at municipal sphere as to which farms or sites should be tested. The selection of targeted surveillance is based on the increased likelihood of infection in particular localities or species. Serological and virological methods should be used concurrently to define the avian influenza status of high-risk populations.

Annexure 25 presents work methods and procedures for specimen collection during the serological surveillance of poultry.

The discovery of clusters of seropositive flocks may reflect any of a series of events, including but not limited to the demographics of the population sampled, vaccinal exposure or infection. Clustering of positive flocks is always epidemiologically significant and therefore should be investigated. If vaccination cannot be excluded as the cause of positive serological reactions, diagnostic methods to differentiate antibodies due to infection or vaccination should be employed (World Organisation for Animal Health, 2007a, p.33).
The results of random or targeted serological surveys are important in providing reliable evidence of avian influenza infection in a country. Highly pathogenic avian influenza has never occurred in South Africa in the poultry industry, however the highly pathogenic virus of H5N2 sub-type was isolated from ostriches in the Eastern Cape province in July 2004. Avian influenza viruses were found in ostriches in South Africa in 1991, 1994 and 1995. A targeted serological surveillance approach must be followed that will allow the early detection of an avian influenza outbreak in all possible high-risk areas (Pienaar & Horner, 2005, p.8).

Serological surveillance as part of control programmes to detect the circulation of the H5N1 virus is considered to be of limited value if used in isolation because most infected birds, e.g. chickens die before they develop a detectable antibody response. Most birds surviving outbreaks are likely not to have been infected (Food and Agriculture Organization of the United Nations, 2007). It is therefore important that serological and clinical surveillance be seen as parallel and ongoing processes. The section below describes virological surveillance of birds.

### 4.4.4 Virological surveillance of birds

The objective of virological surveillance is to (Pienaar and Horner, 2005, p.49):

- confirm clinically suspected cases;
- follow up positive serological results;
- monitor at-risk populations;
- test ‘normal’ daily mortality;
- ensure early detection of infection in the face of vaccination; and
- establish epidemiological links to an outbreak.

A schematic representation of laboratory tests for determining evidence of avian influenza infection by using virological methods is presented in

4.5 Conclusion
Avian influenza surveillance is a continuous and systematic process of standardized information collection, the analysis, interpretation, and dissemination of descriptive information of avian influenza monitoring activities. For the purpose of this study, human avian influenza surveillance was discussed in terms of the following core surveillance activities:

- Case detection;
- Reporting of a notifiable disease;
- Investigation; and
- Confirmation.

Surveillance is classified into two types, namely active surveillance and passive surveillance. Both are usually combined within an avian influenza surveillance programme. In South Africa, the current notification system is based on the Health Act, 1977 (Act 63 of 1977). Each avian influenza surveillance case must be reported to the local health department and the Provincial Department of Health, who then report to the National Department of Health and subsequently to the World Health Organization.

A public health surveillance system is dependent on a clear case definition of the health-related event under surveillance. An avian influenza case reporting form should be standardized so that whenever possible, the same information is recorded for each case.

The early detection of an avian influenza outbreak is dependent on an effective avian influenza surveillance system. Even a single confirmed case is
the epidemic threshold for an avian influenza outbreak investigation. Once an avian influenza outbreak has been identified, routine passive surveillance should be replaced by active surveillance. This implies that the outbreak must be investigated immediately.

The ability to efficiently control the spread of highly pathogenic H5N1 avian influenza is dependent upon the capacity to rapidly detect the pathogen if introduced. An avian influenza surveillance strategy should focus on the early detection of morbidity and mortality in birds, rapid reporting and the submission of appropriate biological specimens to approved diagnostic laboratories.

The approach for the surveillance for avian influenza in birds should be in the form of a continuing programme with regular and frequent clinical inspection, serological and virological testing of high-risk groups of birds. The surveillance can be random or targeted, especially at places where birds and poultry of different origins are mixed, such as live bird markets, poultry in close proximity to waterfowl or other sources of avian influenza.

Clinical surveillance aims at the detection of clinical signs of birds. Monitoring of production parameters, such as increased mortality, reduced feed and water consumption, presence of clinical signs of a respiratory disease or a drop in egg production, is important for the early detection of avian influenza infection. Clinical surveillance and laboratory testing should always be applied in series to clarify the status of avian influenza suspects.

Serological and virological testing should be targeted to species that may not show clinical signs (e.g. ducks). Serological surveillance can be defined as the systematic collection and testing of blood samples from a target population. Serological surveillance methods can be targeted or random. A targeted serological surveillance approach must be followed that will allow the early detection of an avian influenza outbreak in all possible high-risk areas.
The objective of virological surveillance is to confirm clinically suspect cases, to follow up positive serological results, to monitor at-risk populations and to ensure early detection of infection in the face of vaccination or in establishments epidemiologically linked to an outbreak. A prerequisite for a successful bird surveillance programme should also include a study of local bird ecology and the concise mapping of bird avian influenza incidences.

Detailed environmental health work methods and procedures during the surveillance of bird flue are attached as Annexures to this chapter and include the following:

- Annexure 17: Active screening process for avian influenza;
- Annexure 18: Initial diagnosis form for notifiable diseases (Form GW17/5);
- Annexure 19: Human avian influenza notification form;
- Annexure 20: Work methods and procedures for human avian influenza specimen collection;
- Annexure 22: Avian influenza infection control measures;
- Annexure 23: Avian influenza-like illness monitoring form;
- Annexure 24: Work methods and procedures for specimen collection during clinical surveillance of birds; and
- Annexure 25: Work methods and procedures for specimen collection during serological surveillance of poultry.

Effective avian influenza surveillance is the premise for successful avian influenza prevention and control. Work methods and procedures for avian influenza control are developed in the next chapter.
CHAPTER FIVE

WORK METHODS AND PROCEDURES FOR THE CONTROL OF AVIAN INFLUENZA

5.1. Introduction

Avian influenza control has been defined as the actions and programmes directed towards preventing and reducing avian influenza incidences and prevalence. In this chapter, work methods and procedures for avian influenza control are developed from four perspectives, namely:

- Basic strategies for avian influenza control;
- control strategies for avian influenza in humans;
- control strategies for avian influenza in birds; and
- the role of Avian Influenza Endemic Outbreak Response Teams.

Firstly, basic strategies for avian influenza control are discussed. These control strategies describe the basic strategies needed to protect people at risk, measures to interrupt the transmission of avian influenza and strategies to eliminate or reduce the sources of infection.

Secondly, control strategies for avian influenza in humans are developed. These control strategies include work methods and procedures for preventing the exposure of workers in health care facilities, vaccination, antiviral drugs, health education and legislative measures.

Thirdly, control strategies for avian influenza in birds are developed. These control strategies includes biosecurity, elimination of infected poultry, vaccination and education.

Fourthly discussed is the establishment of Communicable Disease Outbreak Response Teams. This section focuses on the place and role of
environmental health practitioners in the National, Provincial, District and Sub-district Communicable Disease Outbreak Response Teams. Also discussed is the frequency of meetings for outbreak response teams at the health district and - sub district levels. The basic strategies of avian influenza control are introduced in the section below.

5.2. Basic strategies of avian influenza control
According to Kim-Farley (1997, p.1561), the control of infectious diseases refers to the actions and programmes directed towards reducing disease incidence and prevalence. Connolly (2005, p.125) states that a communicable disease outbreak can be controlled by eliminating or reducing the source of infection, interrupting the transmission of the disease and protecting persons at risk. Furthermore, communicable disease control strategies can be divided into four categories, namely:

- Prevention of exposure: The source of infection must be reduced to prevent the disease spreading to other members of the community. This may involve prompt diagnosis and treatment of cases using standard protocols, isolation of cases, health education, modification of the environment and vector and reservoir control;
- Prevention of infection: Susceptible people should be vaccinated;
- Prevention of disease: Prophylaxis treatment for high-risk people; and
- Prevention of death: through effective health care services delivery.

Webber (1996, p.35I) states that communicable disease control can be directed at the chain of infection, namely the agent, the transmission route, the host and/or the environment. According to Kim-Farley (1997, p.1563), control measures of communicable diseases are multiple and mainly include immunisation, isolation, environmental methods and vector control. From the above, it can be concluded that avian influenza control can be done by developing measures to protect people at risk, measures to interrupt the transmission of avian influenza and strategies to eliminate or reduce the
source of infection. The section below discusses the control strategies for avian influenza in humans.

5.3. **Control strategies for avian influenza in humans**

According to the World Health Organisation (2004b, p.15) human avian influenza control strategies should be aimed at efforts to prevent infection and control measures to reduce opportunities for further transmission of the disease. Human avian influenza control measures include the following:

- Preventing the exposure of workers in health care facilities;
- vaccination;
- antiviral drugs;
- health education; and
- legislative measures.

In the following sections the above mentioned control measures will be discussed. Firstly is preventing the exposure of workers in health care facilities.

5.3.1. **Preventing the exposure of workers in health care facilities**

The World Health Organization (2006a, p.5) regards every case of transmission of an avian influenza virus to humans as a cause for concern, which requires heightened vigilance and increased surveillance. Generally, health care workers will be the first line of workers at health services that come in contact with suspected or infected avian influenza patients. It is therefore important to provide them with protection against the hazards associated with the virus. The prompt identification and isolation of patients, healthcare employees and visitors who may be infected is critical to minimise the risk of nosocomial transmission and to enable an efficient public health response. Health care workers include people working in a health care facility, e.g., medical officers, nurses, physiotherapists, cleaners, psychologists, laboratory workers, ambulance drivers, etc.
In an era of emerging and re-emerging communicable diseases, basic infection control precautions are the cornerstone of the approach to prevent transmission of communicable diseases in health care facilities. The basic level of infection control precautions (standard precautions), will be effective in preventing transmission of most communicable diseases in health care facilities. The European Commission for Disease Prevention and Control (2007, p.13) describes infection control precautions as the measures intended to reduce the risk of transmission from an infected person to uninfected persons (e.g. hand and respiratory hygiene, masks and respirators and disinfection).

During the 1997 human avian influenza A (H5N1) outbreak in Hong Kong, no nosocomial spread of the virus was observed when droplet and contact precautions were used at health care facilities (Salgado, 2002, p.145). According to Beigel (2005, p.1375), there is no evidence to suggest that airborne human-to-human transmission of avian influenza A (H5N1) has occurred thus far where strict droplet and contact precautions were used at health care facilities.

In general, the transmission of human influenza viruses occurs through multiple routes - including large droplets, direct and indirect contact, and droplet nuclei (Goldman, 2000, p.102). Observational studies conducted at healthcare facilities suggest that droplet transmission is the major mode of transmission in health care settings (Scott, Kerr and Carman, 2002, p.249) and that standard plus droplet precautions are recommended for the care of patients infected with the virus. Against the background of what has been discussed in this section, work methods and procedures for health care workers providing care to avian influenza infected patients at health care facilities have been developed and presented in Annexure 27. The following section discusses avian influenza prevention by vaccination.
5.3.2. Avian influenza control by vaccination

According to the World Health Organization (2007d, p.8), human H5N1 vaccines are anticipated to be one of the major pharmaceutical interventions against a pandemic of H5N1 influenza, but this vaccine has not been widely used in human populations yet. The development of human H5N1 influenza vaccines offers an additional option of control and could potentially be used in the area surrounding a local outbreak, to dampen the possibility of the virus spreading. In this way, H5N1 vaccines could be used as an adjunct to other immediate containment efforts.

The European Commission for Disease Prevention and Control (2007, p.8) states that published data in Europe and data disclosed confidentially by industries identified no serious concerns in the use of human H5N1 influenza vaccines. The data available so far suggest that human H5N1 influenza vaccines should be safe and effective in protecting humans against H5N1 influenza. This is in line with presentations made at two World Health Organization meetings on the clinical trial results of a range of pandemic candidate vaccines (including H5N1) in November 2005 and May 2006. None of the pandemic prototype vaccines tested was associated with additional safety issues and all were well tolerated in the age groups studied. Furthermore, it should be noted that the H5N1 influenza vaccines explained above must be referred to as pre-pandemic vaccines because there is no guarantee that the next human influenza pandemic will evolve from the current H5N1 avian influenza strain. The human H5N1 vaccine "H5N1" remains the only possible candidate strain for the next pandemic, albeit a worrying candidate, because of its persistence in poultry and high pathogenicity in humans.

Nagpal (personal communication, December 15, 2006) stated that no pandemic vaccine is in existence. No direct evidence can be available ahead of a pandemic, though it is likely that a vaccine developed from the pandemic strain will be effective. Availability of any pandemic vaccine will be minimal
during the first pandemic wave as it can take months to develop the ideal vaccine.

Scientific studies suggest there would likely be some protective effect against an H5-based pandemic even if the pandemic strain had changed somewhat from the current H5N1 viruses circulating in birds. Modelling work has suggested that the strategy of having a stockpiled vaccine (and possibly deploying it in advance), even if incompletely matched to the pandemic virus, may prevent more infections and deaths than waiting for specific ‘true’ pandemic vaccines (Ferguson, 2006, p.448; Germann, 2006, p.5935).

The World Health Organization (2007d, p.18) identified five general options for considering the use of human H5N1 influenza vaccines. The first three of the options relate to non-pandemic periods, i.e., when H5N1 infections of people are zoonotic and the identity of the next pandemic influenza virus is unknown. The other two options relate to the early stage outbreaks with pandemic potential, that is if an H5N1 pandemic appeared imminent or was under way. The different options are listed below.

- To protect people at high risk of contracting zoonotic avian H5N1 influenza;
- to “prime” the immune systems of people in selected groups or populations in anticipation of a possible H5N1 influenza pandemic;
- to fully immunize people in selected groups or populations in anticipation of a possible H5N1 influenza pandemic;
- to help contain the initial and localised emergence of a potential H5N1 influenza pandemic; and
- to immunise people in selected groups or populations following sustained human-to-human transmission of an H5N1 influenza virus.

Although vaccination against avian influenza may deliver a variety of desirable outcomes, including potentially reducing virus transmission in populations with
high vaccination levels, the most important outcomes would be the protection of vaccinated individuals against severe disease, hospitalisation and premature death.

5.3.3. **Avian influenza control by antiviral drugs**

Antiviral drugs have demonstrated efficacy in the treatment and prevention of seasonal influenza. Additional research is needed on the role of antiviral drugs in the treatment and prophylaxis of avian influenza. Older inhibitor antiviral drugs like amantidine and ramantidine are ineffective against avian influenza A (H5N1) in vitro (Hayden, 2004, p.874). According to Zeitlin and Maslow (2005, p.193), avian influenza A (H5N1) is susceptible in vitro to neuraminidase inhibitors (oseltamivir and zanamavir). The optimal dose and duration of treatment for avian influenza with neuraminidase inhibitors are unknown.

In Europe much reliance is being put on the use of antiviral drugs (mostly oseltamivir - commercially known as Tamiflu) for prophylaxis or early treatment for the pandemic influenza strains (European Commission for Disease Prevention and Control, 2007, p.13). The use of antiviral drugs as prophylaxis in reducing transmission of avian influenza is only effective when given early enough following exposure or development of symptoms (Hayden 2004, p.874). According to Halloran and Haydon (2007, p.212) as well as Jefferson (2006, p.303), oseltamivir and zanamavir (commercially known as relenza), influenza A treatment drugs are effective in reducing symptoms but not in eliminating the experience of symptoms.

The Western Cape Department of Health (2006, p.8) states that oseltamivir may reduce the severity and duration of illness, provided it is administered early in the course of the illness, i.e., within 48 hours after onset of symptoms. The currently recommended doses for treatment of influenza A per mouth intake are:
i) **Adults:**
   - 75 mg twice a day for five days

ii) **Children 1 year of age or older:** (weight adjusted doses):
   - 30 mg twice daily for ≤ 15 kg
   - 45 mg twice daily for >15 to 23 kg
   - 60 mg twice daily for >23 to 40 kg
   - 75 mg twice daily for >40 kg

iii) **Children < 1 year of age:**
   - Not recommended

At present, there is no clear evidence that shows that higher dosages than the recommended ones will be more effective for patients with H5N1. Because the optimal dosage has not been resolved by clinical trials, and because H5N1 infections continue to have a high mortality rate, prospective studies are needed urgently to determine optimal dosage and duration of treatment for H5N1. The World Health Organization will continue to monitor the situation and will provide updates on the availability of clinically important new information related to the optimal dosage and duration of treatment with oseltamivir for H5N1-infected persons (World Health Organization, 2007d, p.5). In the next section avian influenza health education is discussed.

### 5.3.4. Avian influenza education

According to Connolly (2005, p.88), health education and community participation during intervention strategies play a key role in avian influenza prevention and control. Avian influenza education strategies should focus on specific human behaviour that can contribute to reducing the risk of H5N1 transmission. The reasons for focusing on specific human behaviour are listed below (Food and Agriculture Organization of the United Nations, 2006, p.2):

- At present the extended spread of the H5N1 virus among animals is of great concern and therefore human behaviour reduces the further
dissemination of the virus and needs to be addressed as an entry point for reducing the risk of human infection;

- information about the spread of the virus in birds and the specific risk factors that have led to human infection is limited - therefore there will be a need to adjust the behavioural interventions as more evidence becomes available; and

- behaviour change requires addressing important socio-cultural and economic factors, such as compensation for reporting sick/dead birds at the community level.

The expected human actions at community level during an avian influenza outbreak should include the following (Food and Agriculture Organization of the United Nations, 2006, p.2):

- Report unusual sickness/death among poultry, wild birds and other animals immediately to the health authorities;
- People should immediately seek medical treatment if they experience fever after contact with sick birds;
- Wash hands frequently with soap and water;
- Clean clothes, footwear, vehicles and cages with soap or disinfectant;
- Separate poultry species from wild birds, new birds and living areas;
- Handle, prepare and consume poultry safely; and
- Burn and/or bury dead birds safely.

From the above it can be concluded that health education is a strategy to change human behaviour to concur with the principles of avian influenza control. In Annexure 28 prevention and control guidelines for people living in areas affected by avian influenza are presented. The objective of the guidelines is to provide the general public during an avian influenza outbreak with specific work - procedures to be followed in an attempt to reduce the risk of H5N1 transmission. Environmental health practitioners should bring this
information under the attention of the public. In the next section legislative measures for avian influenza control are discussed.

5.3.5. Legislative measures for the control of avian influenza

Avian influenza control can only be carried out and maintained effectively by legislative measures (National Department of Health, 2006, p.13). Legislative measures in this context refer to the regulations and laws that relate to avian influenza control. In South Africa, a number of legislative measures regarding the control of the disease exist. These include the:

- International Health Regulations, 2005;
- Terrestrial Animal Health Code, 2005;
- National Health Act, 2004 (Act 61 of 2003);
- Animal Diseases Act, 1984 (Act 35 of 1984); and the

The abovementioned legislations were discussed in Chapter Two (see sections 2.3.1.2. and 2.3.1.3.). Any avian influenza control strategy must comply with the said legislation. In analysing the abovementioned legislations it becomes noticeable that no provision is made for work methods and procedures on how to execute the legal requirements. This situation contributed to the need for this study and is supported by the Provincial Communicable Control Co-ordinators (group of experts) (see Chapter One). The control strategies for bird avian influenza cases are discussed in the next section.

5.4. Control strategies for bird avian influenza cases

According to the World Organization for Animal Health (2008, p.2), measures for the control of avian influenza must be aimed at halting further spread in birds and minimising economic losses. The said measures need to be closely coordinated with measures that minimise the longer-term risks to human health. Control strategies aimed at eliminating the disease in birds will also
reduce the presence of the virus in the environment and thus reduce opportunities for human exposure and infections. The elimination of infection in birds can be a complex, difficult, and a costly undertaking. Outbreaks can be controlled through immediate culling of infected flocks, quarantine and disinfection of farms, strict biosecurity, restrictions on the movement of animals and compensation for farmers.

The objectives of an avian influenza control programme for birds should be directed towards the prevention, control and eradication of the avian influenza outbreak (Swane and Akey, 2003, p.113). The said objectives can be achieved through various strategies that include the following:

- Biosecurity (prevention or reduction to exposure);
- elimination of infected poultry;
- vaccination; and
- education.

The following sections discusses the above mentioned control strategies for birds. Firstly discussed below is biosecurity.

5.4.1. **Biosecurity**

The outbreak of highly pathogenic notifiable avian influenza on farms in the Eastern and Western Cape provinces during 2004 has highlighted various aspects of the poultry industry that are not conducive to efficient disease control. Biosecurity and disease monitoring in particular are important aspects of disease control in order to prevent further problems relating to avian influenza outbreaks in South Africa (Pienaar and Horner, 2005).

According to Swane and Akey (2003, p.115), biosecurity includes best management practices to reduce the risk of introducing an avian influenza virus into a poultry house or farm. In most situations, these practices focus on preventing the following:
• The movement of the avian influenza virus on contaminated equipment, clothing and shoes off farms with infected birds;
• preventing movement of infected poultry or their by-products (e.g., manure); and
• preventing exposure of poultry to wild waterfowl.

In the event of an avian influenza outbreak of birds in a region, farm quarantine must be included in the biosecurity practices. Quarantine as a biosecurity measure means controlling the movement of people, including restrictions to minimise the number of visitors to infected farms. This is best achieved by restricting inbound and outbound movements through circumferential fencing of the farm and locking of the gates, or even better, a manned guard shack to ensure adherence to biosecurity policies. Other high-risk activities must be managed by proper cleaning and disinfection of the following:

• Equipment that is shared between farms;
• decontamination of clothing and shoes of workers (preferably having work clothing and shoes left on the farm with laundering locally);
• having employees dedicated to one farm; and
• having strict rules prohibiting employees from owning backyard or recreational poultry or from visiting other poultry farms or establishments.

For shared employees such as vaccination crews, catch crews, feed truck drivers, service personnel etc., they must diligently practise cleaning and disinfection of equipment (including vehicles), clothing and shoes, and minimise their exposure to the birds. Ideally, poultry farms should be of low density in a geographic area to reduce the ease of farm-to-farm transmission (Capua and Marangon, 2003, p. 353). Against the background of what has been discussed in this section biosecurity work procedures for poultry have been developed and presented in Annexure 29 and were confirmed by the
Provincial Communicable Control Co-ordinators (group of experts) on 31 August 2008. The next section discusses the elimination of infected poultry.

5.4.2. **Elimination of infected poultry**

According to Swane and Akey (2003, p.120), avian influenza-infected poultry flocks can be eliminated through on-farm depopulation and disposal. The depopulation and disposal of infected birds must be performed bearing in mind that this needs to be done in the quickest time span possible to prevent the spread of infection. Euthanasia and disposal is the preferred method of eliminating flocks infected with avian influenza. Depopulation requires two processes:

- Firstly, the rapid, humane euthanasia of large numbers of poultry; and
- Secondly, the disposal of the carcasses in an environmentally safe way.

Work methods and procedures for the elimination of infected poultry are presented in Annexure 30. These procedures were confirmed by the Provincial Communicable Control Co-ordinators (group of experts) on 31 August 2008. The section below discusses vaccination as an avian influenza control strategy.

5.4.3. **Vaccination**

Dealing with avian influenza has become increasingly complex and requires the need to develop control strategies that complement the traditional stamping out approach. Vaccination aims to protect the susceptible population of birds from potential infection, thereby reducing the incidence or the severity of the disease. Vaccination strategies can effectively be used as an emergency effort in the face of an outbreak or as a routine measure in an endemic area (World Organization for Animal Health, 2008, p.2).

According to Van Der Goot, Koch, De Jong and Van Boven (2005, p.1814), vaccination can be a powerful tool to support eradication programmes if used
in conjunction with other control methods that include biosecurity and monitoring of the evolution of the infection. Vaccination has been shown to increase resistance and reduce transmission of the virus. It is important to note that on the one hand, vaccinated birds shed fewer viruses; on the other hand, they do not show any clinical signs of disease and could therefore act as silent carriers (Capua and Marangon, 2006, p.1319).

Swayne, Beck and Mickle (1997, p.122) state that the vaccination of poultry with avian influenza vaccines can decrease the susceptibility of poultry to the virus. Vaccination with inactivated whole AI-virus, or recombinant live AI-virus vaccines prevented clinical disease and mortality, and decreased replication and shedding of the field virus from respiratory and digestive tracts. However, vaccines do not completely prevent infection, especially in the field, thus biosecurity practices are essential to prevent spread between vaccinated flocks that may become infected (Capua and Marangon 2003, p.335; Swayne 2003, p.201).

From a South African perspective, vaccination is currently not considered as a possible control measure in the case of an outbreak of highly pathogenic avian influenza, as the slaughter-out of all infected birds is the current control policy to be followed. Vaccination as a possible control measure will only be considered during an uncontrollable outbreak of highly pathogenic avian influenza in the country. This is where the disease is spreading very rapidly or where the disease is occurring on more than a single front, or in more than one province. Vaccination will be employed in conjunction with slaughtering-out, as a defence ring to prevent spread of the disease. While slaughtering-out is taking place inside the ‘line of defence’ all vaccinated birds will be slaughtered eventually, as the presence of antibodies (even if due to vaccination) will confuse future routine serological surveillance (nor withstanding the use of the DIVA principle (differentiating infected from vaccinated animals). Serological surveillance would be one of the important tools used to establish the disease status in the area or country (Pienaar &
Horner, 2005, p.66). The next section discusses education as a control strategy for avian influenza control in birds.

5.4.4. **Avian influenza education**

According to Swane and Akey (2003, p.120), education is an essential component of any avian influenza prevention, control or eradication strategy. This involves providing information to the industry and farm workers concerning:

- The biology of avian influenza viruses;
- how the avian influenza virus is transmitted and the identification of the virus;
- how the virus is introduced and how it spread on farms;
- elimination of behaviours that put the farm at risk for avian influenza introduction (e.g., owning backyard poultry, working on or visiting multiple poultry farms);
- the application of methods and practices in biosecurity to prevent the introduction of the avian influenza virus onto a farm (exclusion biosecurity practices);
- biosecurity practices to prevent the avian influenza virus from leaving a farm (inclusion biosecurity practices); and
- risk communication, which is essential between companies or farms when avian influenza-infected premises is identified.

The next section discusses the role of Avian Influenza Endemic Outbreak Response Teams.

5.5 **The role of Avian Influenza Endemic Outbreak Response Teams**

As discussed in section 4.4, once a disease surveillance system detects an outbreak of avian influenza, Endemic Outbreak Response Teams must be formed. The responsibilities of Endemic Outbreak Response Teams at the different spheres of government in the event of a communicable disease
outbreak are described from a national and provincial perspective in a document entitled *Guidelines for outbreak response and epidemic management* (National Department of Health, 2000).

According to the Mpumalanga Provincial Health Department (2006, p.7), the overall aim of Endemic Outbreak Response Teams is to identify infectious disease outbreaks, conduct surveillance, prepare for emergencies, ensure a rapid response and to promote the systematic management of outbreaks in order to reduce morbidity, disability and mortality.

In practice, an Endemic Outbreak Response Team should be established before an outbreak occurs. Members of the said team are normally performing their usual roles, but in the event of an outbreak of avian influenza, they come together to undertake the said functions. The next section discusses the place and role of environmental health in the National Communicable Disease Outbreak Response Team.

### 5.5.1. The place and role of environmental health in the National Communicable Disease Outbreak Response Team

According to National Departments of Health (2006, p.16), the Deputy-Director General of the National Department of Health is responsible for providing leadership to the multidisciplinary disease outbreak response teams involved in the development of avian influenza preparedness strategies at national, provincial and municipal health departments. The Deputy-Director General, together with the National Institute for Communicable Diseases and health partners from the private sector are responsible to establish and sustain well-constituted and well-functioning outbreak response teams at the different spheres of government in order to give effect to avian influenza pandemic preparedness strategies.

The overall aim of the National Outbreak Response Team with regard to avian influenza is to (National Department of Health, 2006, p.18):
• Provide leadership;
• identify avian influenza outbreaks by ensuring the existence of a functional surveillance system in the country;
• investigate avian influenza outbreaks in the country;
• prepare adequately and timeously for emergencies;
• ensure rapid response and systematic management of avian influenza outbreaks, in order to reduce morbidity and mortality; and
• enhance coordination at each sphere of government.

According to the National Department of Health (2006, p.15) a number of sectors acts on the National Outbreak Response Team in South Africa. These sectors play different, yet complementary roles in the National Outbreak Response Team. The National Directorate: Environmental Health forms part of the National Outbreak Response Team. Annexure 31 represents the list of sectors involved in the said outbreak response team. Not all the sectors are present during the routine monthly meetings, but the presence of all can be requested during an avian influenza outbreak.

According to Ramkrishna (personal communication, June 11, 2007), the National Directorate: Environmental Health must provide leadership to environmental health practitioners in the provincial and municipal spheres regarding their role in influenza outbreak response teams. This includes the following:

• Conduct environmental assessments and management of risk factors predisposing individuals to influenza;
• collect environmental samples for laboratory testing in order to confirm sources of outbreaks; and
• coordinate port health activities.

Detailed roles and responsibilities of the different sectors within the National Outbreak Response Team can be found in the influenza preparedness plans
of the National Department of Health (2006). In the following section the place and role of environmental health in Provincial Outbreak Response Teams are discussed.

5.5.2. The place and role of environmental health in a Provincial Outbreak Response Team

At the provincial sphere, a Provincial Outbreak Control Coordinator has been appointed for each of the nine provinces in South Africa (Tshabalala-Msimang, 2004). These coordinators have the responsibility to establish multidisciplinary Provincial Outbreak Control Teams and to prevent and control disease outbreaks in their provinces (National Department of Health, 2000, pp.5-7).

The multidisciplinary Provincial Outbreak Response Team is made up of the following sectors and was confirmed by the Provincial Communicable Control Co-ordinators (group of experts) on 31 August 2008:

- Communicable Disease Control;
- Clinical Care;
- Surveillance / Epidemiology;
- Environmental Health; and
- Health Promotion.

The above sectors, together with the Department of Agriculture, are also responsible for epidemiological investigations at the provincial sphere. However, there are additional sectors that can form part of the overall Provincial Outbreak Response Team during disease outbreaks. These include the following sectors at the provincial sphere and were confirmed by the Provincial Communicable Control Co-ordinators (group of experts) on 31 August 2008:

- Pharmaceutical Services;
- Communication;
• Hospital Management;
• Emergency Medical Services;
• Disaster Management Units;
• Primary Health Care Teams;
• Infection Control Teams;
• Occupational Health Unit;
• Expanded Programme on Immunisation (EPI) Section;
• Human Resources Section;
• Mental Health, Nutrition, and Information units;
• Departments of Water Affairs and Forestry;
• Defence;
• Local Government;
• Education;
• Non-governmental organisations;
• International agencies;
• Civic structures; and
• Community structures.

Nagpal (2006, p.15) proposes a similar list and added several important sectors that should be part of the Provincial Outbreak Response Team of the Eastern Cape province (See Annexure 32).

According to Gouws (2006, p.10) a Provincial Outbreak Response Team is chaired by the Provincial Outbreak Coordinator who reports to the Chief Director: Communicable Diseases at the National Department of Health and to the Head of the Health Department in the provincial sphere. The Provincial Outbreak Response Team can co-opt any member of the private sector with specialised expertise to advise it on certain matters. It is the role of the Provincial Outbreak Response Team to ensure that an integrated and uniform approach is followed in dealing with avian influenza outbreaks. A further function of the Provincial Outbreak Response Team is to assist in planning,
formulating policy guidelines, providing information, providing physical and financial support, providing training, research and capacity building on avian influenza surveillance and control which will continually be executed at provincial sphere.

A key function of the Deputy-Director: Environmental Health in the Eastern Cape province, who should form part of the Provincial Outbreak Response Team, is to monitor and ensure the implementation of preparedness plans in the provincial and local spheres (Wild, personal communication, May 7, 2007). The said Deputy-Director is also responsible for the training of environmental health practitioners at district and sub-district levels within the Eastern Cape province on epidemiological avian influenza investigations. The next section discusses the place and role of environmental health within a District Outbreak Response Team.

5.5.3. The place and role of environmental health in a Health District Outbreak Response Team

In the Eastern Cape province, district municipalities (Category C municipalities) have established their own District Outbreak Response Teams (Agenbag, personal communication, April 2, 2007 and Dreyer, personal communication, February 19, 2007). In the case of the Nelson Mandela Metropolitan Municipality, a Metropolitan Outbreak Response Team is in existence (Oliphant, personal communication, February 5, 2007). The list below reflects the sectors that are currently part of the Metropolitan Outbreak Response Team in the Nelson Mandela Metropolitan Municipality in the Eastern Cape province (Oliphant, personal communication, February 5, 2007 and Masiso, personal communication, January 29, 2007):

- A senior environmental health practitioner from the metropolitan municipality (Category A municipality);
- the Health District Manager of the Nelson Mandela Metropolitan Municipality;
• doctors and nurses from both public and private hospitals within the municipality;
• representatives from the local Disaster Management Committee;
• an epidemiologist from a tertiary educational institution;
• veterinarians from the Department of Agriculture in the municipality;
• a representative from the Provincial Department of Health;
• environmental health practitioners from the metropolitan sub councils; and
• representatives from relevant private organisations in the metropolitan municipality.

The District Outbreak Response Teams of the District Municipalities (Category C municipalities in the Eastern Cape province have similar compositions (Agenbag, personal communication, April 2, 2007 and Dreyer, personal communication, February 19, 2007). According to the Eastern Cape Department of Health (2001, p.5), in all the Health Districts in the Eastern Cape province an Outbreak Task Team should be established composed of the:

• District Manager;
• District Communicable Disease Coordinator (convener);
• district information manager;
• district maternal and child coordinator;
• medical doctor from the district hospital;
• district environmental health practitioner;
• district pharmacist;
• district laboratory coordinator;
• environmental health practitioner from each sub-district within the health district; and
• a community health nurse from each sub-district within the health district.

The District Outbreak Response Team is responsible for collecting and providing information and reports to the Provincial Outbreak Response Team.
Gouws (2006, p.17), is of the opinion that the District Environmental Health Manager should chair the disease outbreak response team meetings at the district (Category C municipality) level.

From Section 1 of the **National Health Act**, 2004 (Act 61 of 2003) it was deduced that the surveillance and prevention of communicable diseases is a function of environmental health practitioners at the municipal sphere of government. According to Bezana (personal communication, June 10, 2007), the role of environmental health practitioners in relation to the surveillance and prevention of communicable diseases must be the anticipation, identification and assessment of environmental health risk factors through:

- inspections;
- investigations;
- research and monitoring;
- analysis of surveillance information;
- risk assessment for the purpose of determining the appropriate remedial or preventative measures;
- the implementation of remedial or preventative measures;
- re-monitoring for establishing the effectiveness of measures taken; and
- to provide a surveillance system that will prevent the re-introduction of an infection.

Agenbag (personal communication, April 2, 2007) states that environmental health practitioners should play a leading role in coordinating and facilitating the surveillance and control of avian influenza in a District Outbreak Response Team. From an environmental health point of view, there is currently no team in place that deals specifically with the surveillance and control of avian influenza in the Eastern Cape province. It is therefore important to establish specialist teams for environmental health at health district level that can deal with the surveillance and control of avian influenza. Oliphant (personal communication, February 5, 2007) agrees with Agenbag and added that
environmental health practitioners represented on such a team should not only have the theoretical knowledge, but also practical experience. The next section discusses the place and role of environmental health in a Health Sub-District Outbreak Response Team.

5.5.4. The place and role of environmental health in a Health Sub-District Outbreak Response Team

Each municipal sub-district within the Ukhahlamba and Cacadu District Municipalities as well as the metropolitan sub-councils in the Nelson Mandela Metropolitan Municipality in the Eastern Cape province established Sub-District / Metropolitan Sub-Council Outbreak Response Teams in consultation with the relevant role players. These teams generally consist of nurses from clinics, local doctors and an environmental health practitioner. These teams are less structured than the District Outbreak Response Teams and meets on an ad-hoc basis (Agenbag, personal communication, April 2, 2007). According to Dreyer, (personal communication, February 2, 2007), the Sub-District Outbreak Teams should meet on a weekly basis and an environmental health practitioner should be part of the said teams. A representative of the Sub-district Outbreak Response Team should attend the monthly meetings of the District Outbreak Response Team. Titus (personal communication, February 2, 2007) states that environmental health practitioners should not always wait for information on avian influenza from nurses, clinics and hospitals but should play a more pro-active role and conduct surveillance strategies to identify individuals and places at risk within their respective areas of jurisdiction.

According to Gouws (personal communication, December 5, 2007), the Sub-District Outbreak Response Teams should promote an integrated and coordinated approach to avian influenza surveillance and control in a municipal area. All government organs and role-players within a health sub-district should put special emphasis on the prevention / mitigation of an avian influenza outbreak. Sub-district Outbreak Response Teams should act as a repository and a conduit for information concerning avian influenza outbreaks
within their areas of jurisdiction. Sub-district Outbreak Response Teams should also promote avian influenza surveillance and control by capacity building, training and education in the communities that are vulnerable to an avian influenza outbreak. Sub-district Outbreak Response Team should promote the recruitment, training and participation of volunteers in the event of an avian influenza outbreak in a municipal/sub-district area.

According to Oliphant (personal communication, February 5, 2007) avian influenza training needs should be included in the integrated development plans of municipalities and should be part of the annual municipal budget. This will ensure that avian influenza preparedness strategies become a priority within the municipal sphere. The next section discusses the frequency of meetings for outbreak response teams at the municipal sphere of government.

5.5.5. **Frequency of meetings of outbreak response teams at the municipal sphere of government**

According to Gouws (2006, p.68), the frequency of meetings at the municipal sphere will depend on the development of the epidemiological situation. During outbreaks, it is recommended that the team meet on a daily basis. The frequency may be reduced depending on the extent of the outbreak. When the control measures are launched and when epidemiological surveillance data show no more extension of the epidemic, a weekly meeting may suffice. During every team meeting, the responsibilities of members should be reviewed in order to ensure the success of control actions. Outbreak coordinators should ensure proper secretarial support and proper minutes must be kept of each meeting. The minutes of the monthly District Outbreak Response Team meetings must be captured electronically on the District Health Information System (DHIS) that is linked with the Provincial and National Health Departments (Erasmus, personal communication, June 5, 2007).
According to Agenbag (personal communication, April 2, 2007), communication amongst outbreak response teams from different districts in the Eastern Cape province is poor. Due to the avian influenza outbreaks that occurred previously in the province, monthly meetings are advisable during non-outbreak periods. Outbreak response teams should systematically assess the trends of avian influenza outbreaks and continuously review the implementation of existing preparedness plans.

5.6. Conclusion

Avian influenza control includes all the actions and programmes directed towards preventing and reducing avian influenza incidences and prevalence. In this chapter, strategies for avian influenza control were developed from four perspectives, namely basic strategies for avian influenza control, control strategies for avian influenza in humans, control strategies for avian influenza in birds, and the role of avian influenza endemic outbreak response teams.

Most documentary sources discuss avian influenza control under two main categories, namely control strategies for avian influenza in humans; and the control of avian influenza in birds. Control strategies for avian influenza in humans were identified and developed in terms of the following: work methods and procedures for preventing the exposure of workers in health care facilities, avian influenza control by vaccination, avian influenza control by antiviral drugs, avian influenza control by health education and legislative measures for the control of avian influenza. It was found that health care workers are generally the first line of workers at health establishments that come in contact with suspected or infected avian influenza patients. It was therefore important to develop work methods and procedures on how to protect themselves against the hazards associated with the virus.

To date no pandemic vaccine is in existence because it is impossible to predict accurately the genetic make-up of the next pandemic strain. However, the human H5N1 vaccine remains the only possible candidate strain
for the next pandemic. The World Health Organization identified five general options for considering the use of human H5N1 influenza vaccines. If an H5N1 pandemic appeared imminent, or was under way, the use of the H5N1 influenza vaccines should be considered in order to:

- Protect people at high risk of contracting zoonotic avian H5N1 influenza;
- “prime” the immune systems of people in selected groups or populations in anticipation of a possible H5N1 influenza pandemic;
- fully immunize people in selected groups or populations in anticipation of a possible H5N1 influenza pandemic;
- help contain the initial and localized emergence of a potential H5N1 influenza pandemic; and
- immunize people in selected groups or populations following sustained human-to-human transmission of an H5N1 influenza virus.

At present the two antiviral drugs, Oseltamivir and Zanamavir, are used in the treatment of influenza A. Both drugs are effective in reducing symptoms caused by the virus. It is important to note that neither of Oseltamivir or Zanamavir can fully eliminate symptoms caused by the virus. The use of antiviral drugs as prophylaxis in reducing transmission of avian influenza is only effective when given early enough following exposure or the development of symptoms.

It was concluded that health education is a valuable strategy to change human behaviour to conform to the principles of avian influenza control. Prevention and control guidance for people living in areas affected by avian influenza was presented. These guidelines provide specific work procedures to be followed in an attempt to reduce the risk of H5N1 transmission. Avian influenza control can only be carried out and maintained effectively by legislative measures. Hence avian influenza control legislative measures were identified and discussed.
Control strategies for avian influenza in birds were also identified and discussed. These control strategies include work methods and procedures for biosecurity as an avian influenza control strategy of birds, elimination of infected poultry; vaccination as an avian influenza control strategy in birds and education as a control strategy for avian influenza in birds. Control strategies aimed at eliminating the disease in birds will reduce the presence of the virus in the environment and thus reduce opportunities for human exposure and infections.

Lastly discussed was the establishment of Communicable Disease Outbreak Response Teams. An avian outbreak investigation and its control is a multidisciplinary endeavour that needs close collaboration within the different spheres of government. When an avian influenza outbreak occurs, an Avian Influenza Outbreak Control Team should be set up immediately by the Outbreak Control Coordinator of the affected Health District. The said team should implement outbreak investigations and control measures in cooperation with relevant staff from the provincial and national health departments. The place and role of environmental health in the national, provincial, district and sub-district communicable disease outbreak response teams were identified and discussed. The success of avian influenza control strategies depend on the cooperation of relevant role players within these spheres of government. In the next chapter, a conclusion with emphasis on the findings of the study will be presented. Applicable recommendations will also be made.
CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

The purpose and significance of this study were presented in Chapter One. The general purpose of this study was to develop a standardised set of Environmental Health work methods and procedures, which will contribute to effective avian influenza surveillance and control in the Eastern Cape province – South Africa. More specifically, the purpose of this study was to:

- Firstly, analyse the national health care system with specific reference to the place and role of environmental health practitioners at national, provincial and municipal spheres – in relation to avian influenza surveillance and control - with the purpose of identifying inadequacies and making appropriate recommendations;
- Secondly, analyse and describe the epidemiology of avian influenza, with the focus on the distribution and characteristics of the disease in South Africa as a prerequisite for the development of work methods and procedures for the surveillance and control of the disease; and
- Thirdly, to analyse relevant research that have been done globally and to use it, against the background of the above, to scientifically develop work methods and procedures to be used by environmental health practitioners during the surveillance and control of avian influenza in the Eastern Cape province – South Africa.

The researcher followed an explorative, descriptive, inductive and deductive research design. The methods of data collection were documentary research, telephonic as well as in-depth personal interviews. The research population used during this study comprised two groups (also referred to as the sample groups) as listed below.

- Group 1: The nine Provincial Communicable Disease Outbreak Control
Co-ordinators (a group of experts); and

- Group 2: Managerial and line function personnel from two of the six District (Category C) Municipalities and the only Metropolitan (Category A) Municipality in the Eastern Cape province.

A documentary research approach was employed as the primary method of data collection for the study. Relevant research data were collected from government legislation and publications, official national and international statistics, as well as other national and international publications.

The researcher has used questions in a telephonic interview schedule to obtain relevant information from the participants in the group of experts. The purpose of using a telephonic questionnaire for participants in this group was to draw on their knowledge and experience of communicable disease surveillance and control in relation to avian influenza as well as their views on the role of the Environmental Health Practitioners in the Communicable Disease Outbreak Response Teams at the three different spheres of government.

In order to obtain additional information (information such as the organisational structure of the health care system in the Eastern Cape province), the current status of avian influenza Outbreak Response Teams, functional and managerial problems), semi-structured personal interviews with relevant role-players in the municipal sphere of government were conducted, namely with managerial and line function personnel from two of the six District (Category C) Municipalities (Ukhahlamba District Municipality and Cacadu District Municipality) and managerial and line-function personnel from the Nelson Mandela Metropolitan (Category A) Municipality in the Eastern Cape province.
The process of qualitative data analysis was followed based on data reduction and interpretation; and was conducted as an activity simultaneously with data collection, data interpretation and narrative report writing.

In Chapter Two, an attempt was made to define Environmental Health. It was deduced that Environmental Health is a science that not only studies how the environment influences human health, but also how the environment influences disease. The deduction was made that the environment (i.e., air, water and soil) has physical, chemical, biological and social features and that it is the influence that these features have on human health that the “science” of environmental health is studying. Furthermore, environmental health can be regarded as a facet of public health that involves the analysis (assessing, identification) of the said factors in the environment and the introduction of strategies (correcting, controlling and preventing) to rectify or prevent the occurrence of those factors that can potentially adversely affect the state of human health.

The functional areas of the environmental health profession as practiced in South Africa can be deduced from Section 1 of the National Health Act, 2003 (Act 61 of 2003). It was concluded that all the functional areas of the environmental health practitioner, including the scope of the profession as practiced in South Africa correlate with that of the international perspective.

A number of legislative documents relevant to avian influenza surveillance and control were also presented. These included the:

- **Atmospheric Pollution Prevention Act**, 1965 (Act 45 of 1965);
- **Foodstuffs, Cosmetics and Disinfectants Act**, 1972 (Act 54 of 1972);
- **Hazardous Substances Act**, 1973 (Act 15 of 1973);
- **Health Act**, 1977 (Act 63 of 1977);
- **Animal Diseases Act**, 1984 (Act 35 of 1984);
- **Environment Conservation Act**, 1989 (Act 73 of 1989);
• **Occupational Health and Safety Act**, 1993 (Act 85 of 1993);
• **Constitution of the Republic of South Africa Act**, 1996 (Act 108 of 1996);
• **Water Services Act**, 1997 (Act 108 of 1997);
• **National Environmental Management Act**, 1998 (Act 107 of 1998);
• **National Water Act**, 1998 (Act 36 of 1998);
• **Meat Safety Act**, 2000 (Act 40 of 2000);
• **National Health Act**, 2004 (Act 61 of 2003);
• **Terrestrial Animal Health Code**, 2005; and

It was found that the right to health care services is well established within the **Constitution of the Republic of South Africa**, 1996 (Act 108 of 1996). The South African government follows the primary health care philosophy of health care service delivery which includes personal and non-personal health care services (environmental health services). The **Constitution of the Republic of South Africa**, 1996 (Act 108 of 1996) is the supreme law and the foundation of the health care system in South Africa. It gives conspicuous expression to the fundamental right to health care for all; and also rules that the delivery of health care services is a concurrent function in all three spheres of government within a framework of cooperative governance. The development of environmental health work methods and - procedures for the surveillance and control of avian influenza can therefore be regarded as an attempt to fulfill a constitutional imperative.

It was found that the promulgation of the **National Health Act**, 2004 (Act 61 of 2003), provides the legislative basis for the state to unite the various elements of the national health system under a common umbrella and to actively promote and improve the national health system in South Africa. Furthermore, the said act defines the organisational framework for health care service delivery within each of the three spheres of government. The **National Health Act**, 2004 (Act 61 of 2003) is important legislation for the implementation of the constitutional rights on health. This act was promulgated to provide a
framework for a structured and uniform national health system. It delineates the health services in three spheres of government, namely national, provincial and municipal. From the said act, it can be deduced that avian influenza surveillance and control are functions of environmental health practitioners in the municipal sphere of government (‘surveillance and prevention of communicable diseases’ and ‘vector control’).

The organisational structure of the national health system in South Africa was explained and discussed from national, provincial and municipal perspectives. Chapter Two has attempted to describe the national health care system and to identify the place and role of environmental health practitioners within the national, provincial and municipal spheres of government.

An analysis of the national health care system enabled the identification of a number of decision-makers in all three spheres of government that can have an influence on environmental health service delivery. The said decision-makers can play either a direct or an indirect role in the surveillance and control of avian influenza. The organisational analysis of the national sphere (National Department of Health) enabled the identification of the following decision-makers:

- The Minister of Health and the Cabinet;
- members of the National Health Council;
- the National Health Advisory Committee;
- the Director-General of Health;
- the Deputy Director-General: Health Service Delivery;
- the Director: Environmental Health; and
- the National Consultative Health Forum.

It was pointed out that the environmental health decision-makers within the provincial sphere of government (Provincial Department of Health in the Eastern Cape province) include the:
• Member of the Provincial Executive Committee responsible for health and the Provincial Legislature;
• the Provincial Health Council;
• the Chief Director: District Health Services;
• the Director: Primary Health Care; and
• the Deputy Director: Environmental Health.

To be able to identify the environmental health decision-makers within the municipal sphere of government, it was essential to carry out an analysis of the organisational structure of the District Health System as it applies to local government in South Africa. It was therefore necessary to explain what is meant by a Health District, District Health Authority, District Health Council, Health Sub-district and a Local Municipality.

It was stated that the district health system is a fundamental organisational framework of the health care system in South Africa. The Constitution of the Republic of South Africa, 1996 (Act 108 of 1996), prescribes three categories of municipalities, namely Category A (metropolitan municipalities), Category B (local municipalities) and Category C (district municipalities). The six metropolitan municipalities (Category A), together with 46 district (Category C) municipalities constitute the health districts (a total of 52) in South Africa.

In the municipal sphere of government, health care service delivery can be divided into three tiers, namely health districts, health sub-districts and local municipalities. The responsibility for environmental health services is transferred from provinces to the Category A and C municipalities. Environmental health practitioners play an important role in avian influenza surveillance and control within municipal health services.

What became evident from interviews conducted with environmental decision-makers at the municipal sphere is that municipalities must be encouraged to budget appropriately for strategies of avian influenza surveillance and control.
The said municipalities must address avian influenza preparedness plans as an integral part of their annual integrated development plans. It was also found that all too often the value of an environmental health practitioner’s role is acknowledged only when disaster or disease strike, yet health budgets at all spheres of government can be reduced through preventative environmental health measures and timeous monitoring.

From interviews conducted during the study it was found that a need exists for the education of all role players and the training of environmental health practitioners on detailed work methods and procedures for the surveillance and control of avian influenza. Liaison and communication networks need to be strengthened between local municipalities in an attempt to identify and monitor avian influenza outbreaks at an early stage.

In Chapter Three, the epidemiology of avian influenza was presented and discussed. It was found that influenza is a contagious respiratory illness associated with infection by the influenza virus of the virus family Orthomyxoviridae. The illness can present itself in humans and in animals. The influenza virus is genetically highly variable and it is this variability that gives rise to constant changes in the antigenicity of the virus. The antigenic changeability constantly gives rise to new strains of the virus resulting in recurring outbreaks or epidemics.

The influenza virus can be classified into three types based on the antigenicity of the nucleoproteins which surround the RNA genome of the virus. The three types are Type A, Type B and Type C of which Type A is the most virulent and infects mammals and birds. There are two ways in which the influenza virus can change its antigenicity namely, antigenic shift and antigenic drift.

Antigenic shift represents a sudden and major change in antigenicity that gives rise to a completely new subtype of virus (about once every 10-40 years). This can cause dramatic and sudden classical pandemics such as the
1918/19 Spanish Flu, the 1957 Asian flu, and the 1968 Hong Kong flu. Antigenic drift represents a gradual but progressive change which can then spread throughout the human population, causing widespread epidemic activity approximately every three to five years.

The fundamental differences between human seasonal influenza, avian influenza and human pandemic influenza were also presented. Avian influenza, also called fowl plague, avian flu and bird flu, is a highly contagious viral disease with up to 100% mortality in domestic fowl. The avian influenza (H5N1) virus may serve as the origin of a new "human" influenza virus subtype which might then be rapidly transmitted between people and cause a human influenza pandemic. An influenza pandemic (global epidemic) occurs when a new influenza virus subtype emerges that has not previously circulated in humans.

Domestic fowl, ducks, geese, turkeys, guinea fowl, quail and pheasants can be regarded as natural hosts of the avian influenza virus. Ducks have the highest prevalence for the influenza A virus. It is generally accepted that migratory waterfowl, most notably wild ducks, are the natural reservoir of avian influenza viruses, which can be transmitted to domestic bird populations and to commercial poultry. Direct or indirect contact between domestic flocks and wild migratory waterfowl has been implicated as a frequent cause of epidemics in poultry populations.

Transmission of avian influenza viruses to people remains relatively rare and in most cases occurs as a result of direct contact with infected poultry or other birds or their faeces. Normally, avian influenza viruses do not infect humans because of host barriers to infection, such as cell receptor specificities. However, they can occasionally cross the species barrier and directly infect humans, including highly pathogenic strains that have caused a fatal disease in humans. There is evidence that the H5N1 strain of the bird flu virus - which
has been circulating in birds - has a unique capacity to mutate and jump the species barrier causing a disease with a high mortality rate in humans.

The widespread persistence of H5N1 in bird populations poses two main risks to human health. The first is the risk of infection when the virus spreads directly from birds to humans. The second risk, which is of even greater concern, is that there will be increased possibilities for the widely circulating virus to infect humans and possibly reassort into a strain that is both highly infectious for humans that may spread easily from humans-to-humans. Avian influenza has a worldwide occurrence and may occur as a low pathogenic strain (LPAI) or as a high pathogenic (virulent) strain (HPAI). The avian influenza A (H5N1) virus has proved to be especially tenacious. The avian influenza A (H5N1) animal outbreak in Asia and parts of Europe, the Near East, and Africa is not expected to diminish significantly in the short term.

To date no cases of bird flu caused by the HPAI have been reported in South Africa. However, South Africa has had previous occurrences of the less virulent strain LPAI of H6N2 and H5N2. Firstly, in August 2004, H5N2 avian influenza virus was isolated on a farm in the Eastern Cape province and a second H5N2 outbreak was recorded during May 2006 in the Western Cape districts of Mossel Bay and Riversdale. Previously avian influenza viruses were found in ostriches in 1991, 1994 and 1995. LPAI (H6N2) was reported and confirmed for the first time in the commercial chicken industry in South Africa, following outbreaks of the disease in KwaZulu Natal in 2002 and subsequently in Gauteng, the Free State, North-West, Mpumulanga and the Western Cape provinces. The expanding geographic distribution of avian influenza A (H5N1) infections indicates that more human populations are at risk.

The incubation period of the virus in humans is two to four days. Most patients have initial symptoms of high fever (typically a temperature of more than
38°C) and an influenza-like illness with lower respiratory tract symptoms. All countries have their own case definitions that will change as the disease evolves. Countries can use the case definition of the World Health Organization as a template in developing their own avian influenza case definitions.

The impact of an outbreak of HPAI will have devastating consequences on the various sectors of the poultry industry and also for the Southern African region. There would be a simultaneous impact on all communities. The high strike rate would overwhelm health facilities. Socio-economic disruption would ensue. Given the scenario, a well coordinated strategy for preparedness is required at provincial and at district health level for a robust response and to mitigate a pandemic impact.

For international planning purposes, the World Health Organization has defined six phases in the progression of an influenza pandemic from the first emergence of a new influenza virus, to the wide international spread. These phases allow a step wise escalating approach to preparedness planning and response. The Director-General of the World Health Organization has designated a global pandemic alert: Phase Three as of 16 March 2006. South Africa is designated as “not affected”, but is still required to implement measures for Phase Three.

Work methods and - procedures for avian influenza surveillance were developed in Chapter Four. Basic principles of avian influenza surveillance were discussed. It was concluded in this chapter that avian influenza surveillance is a continuous and systematic process of standardized information collection, the analysis, the interpretation and dissemination of descriptive information of avian influenza monitoring activities. Surveillance was classified as active surveillance and passive surveillance; both of these can be combined within an avian influenza surveillance programme. Four core
strategies of human avian influenza surveillance were developed in Chapter Four under the following headings:

- Human case detection;
- Notifiable disease reporting;
- Investigation of an avian influenza outbreak; and
- Human case confirmation.

In South Africa, the current notification system is based on the National Health Act, 2004 (Act 63 of 2003). Each avian influenza surveillance case must be reported to the local Health Department and the Provincial Department of Health, who then report to the National Department of Health and subsequently to the World Health Organization. A public health surveillance system is dependent on a clear case definition of the health-related event under surveillance. Therefore a case definition for avian influenza was developed in **Chapter Four**.

The early detection of an avian influenza outbreak is dependent on an effective avian influenza surveillance programme. Even a single confirmed case is the epidemic threshold for an avian influenza outbreak investigation. Once an avian influenza outbreak has been identified, routine passive surveillance should be replaced by active surveillance. This implies that the outbreak must be investigated immediately.

Work methods and procedures developed for the surveillance of human avian influenza in **Chapter Four** include:

- Work procedures to report human avian influenza;
- Response procedures during an avian influenza outbreak;
- Active screening process for human avian influenza cases;
- Initial diagnosis form for notifiable diseases: Form (GW17/5);
- An avian influenza notification form (Human cases) – Eastern Cape province;
- Work methods and - procedures for human avian influenza specimen collection;
- Avian influenza-like illness monitoring form; and
- Avian influenza infection control measures during surveillance.

The ability to efficiently control the spread of highly pathogenic H5N1 avian influenza is dependent upon the capacity to rapidly detect the pathogen once introduced. An avian influenza surveillance strategy should focus on the early detection of morbidity and mortality in birds, rapid reporting and the submission of appropriate biological specimens to approved diagnostic laboratories.

The approach for the surveillance for avian influenza in birds should be in the form of a continuing programme with regular and frequent clinical inspection, serological and virological testing of high-risk groups of birds. The surveillance can be random or targeted especially at places where birds and poultry of different origins are mixed, such as live bird markets, poultry in close proximity to waterfowl or other sources of avian influenza.

Work methods and - procedures developed for the surveillance of bird avian influenza include:

- Work methods and - procedures for bird specimen collection during clinical surveillance;
- Work methods and - procedures for specimen collection during serological testing of birds; and
- Biosecurity measures to prevent the introduction of avian influenza in birds.
The objective of virological surveillance is to confirm clinically suspect cases, to follow up positive serological results, to monitor at-risk populations and to ensure early detection of infection in the face of vaccination or in establishments epidemiologically linked to an outbreak. A prerequisite for a successful bird surveillance programme should include a study of the local bird ecology and the concise mapping of bird avian influenza incidences.

Work methods and procedures for the different control strategies of avian influenza were developed in Chapter Five. These control strategies include:

- Basic strategies for avian influenza control;
- control strategies for avian influenza in humans;
- control strategies for avian influenza in birds; and
- the role of Avian Influenza Endemic Outbreak Response Teams.

Basic strategies for avian influenza control are aimed at developing measures to protect people at risk, measures to interrupt the transmission of avian influenza and strategies to eliminate or reduce the source of infection.

Work methods and procedures for the control of avian influenza in humans were developed from the following perspectives:

- Preventing the exposure of workers in healthcare facilities;
- Avian influenza control by vaccination;
- Avian influenza control by antiviral drugs;
- Avian influenza health education; and
- Legislative measures.

It was found that health care workers are generally the first line of workers at health establishments that come into contact with suspected or infected avian influenza patients. It was therefore important to develop work methods and procedures on how to protect them against the hazards associated with the
virus. Work methods and procedures for health care workers providing care to avian influenza-infected patients at health facilities were developed under the following headings:

- Work procedures at the arrival of suspected or confirmed avian influenza-infected patients at a health care facility;
- Patient placement for suspected or confirmed avian influenza-infected patients in an isolation room;
- Cohorting of avian influenza infected patients;
- Placement and removal procedures of personal protective equipment when dealing with suspected or confirmed avian influenza-infected patients;
- Procedures on leaving the isolation room;
- Disposal of suspected avian influenza waste; and
- Environmental cleaning and disinfection of rooms and surfaces.

To date no pandemic vaccine for avian influenza is in existence because it is impossible to predict accurately the genetic make-up of the next pandemic influenza strain. The human H5N1 vaccine remains the only possible candidate strain for the next influenza pandemic. The World Health Organization identified five general options for considering the use of human H5N1 influenza vaccines. If an H5N1 pandemic appeared imminent, or was under way, the use of the H5N1 influenza vaccines should be considered in order to:

- Protect people at high risk of contracting zoonotic avian H5N1 influenza;
- “prime” the immune systems of people in selected groups or populations in anticipation of a possible H5N1 influenza pandemic;
- fully immunize people in selected groups or populations in anticipation of a possible H5N1 influenza pandemic;
- help contain the initial and localised emergence of a potential H5N1 influenza pandemic; and
• immunise people in selected groups or populations following sustained human-to-human transmission of an H5N1 influenza virus.

At present the two antiviral drugs, Oseltamivir - commercially known as Tamiflu, and Zanamavir - commercially known as Relenza, are used in the treatment of influenza A. These two antiviral drugs may reduce the severity and duration of illness, provided they are administered early in the course of the illness, i.e. within 48 hours after the onset of symptoms. The currently recommended doses for treatment of influenza A per mouth intake were also presented.

Chapter 5 also addresses health education which is a strategy to change human behaviour to concur with the principles of avian influenza control. Prevention and control advice for people living in areas affected by avian influenza were developed under the following headings:

• Key public messages and advice to prevent the spread of avian influenza in affected areas;
• Proper handling of poultry;
• Decontamination of premises;
• Burying of dead birds and their faeces;
• Handling/disposal of contaminated protective clothing;
• Additional precautions when experiencing flu-like symptoms;
• Precautions to be taken when visiting friends or relatives in health care facilities;
• Precautions to be taken in neighbouring areas (next to the bird-flu affected areas); and
• Precautionary measures to ensure that poultry and poultry products are properly prepared and safe to eat.

Control strategies aimed at eliminating the disease in birds will reduce the presence of the virus in the environment and thus reduce the opportunities for
human exposure and infections. Work methods and procedures for the control of avian influenza in birds were developed from the following perspectives:

- Biosecurity (prevention or reduction to exposure);
- elimination of infected poultry;
- decreasing host susceptibility to the virus (vaccination); and
- education.

Biosecurity and monitoring in particular are important aspects of avian influenza control. Work procedures that describe the minimum biosecurity measures for poultry establishments to prevent the introduction of avian influenza were developed. Also developed in Chapter Five were work methods and procedures for the elimination of infected poultry.

From a South African perspective, vaccination is currently not considered as a possible control measure in the case of an outbreak of highly pathogenic avian influenza. Slaughter of all infected birds is the current control policy to be followed. Vaccination as a possible control measure will only be considered under the following conditions:

- During an uncontrollable outbreak of highly pathogenic avian influenza in the country. This is where the disease is spreading very rapidly or where the disease is occurring on more than a single front, or in more than one province; and
- if an area experiences continued and persistent avian influenza outbreaks.

Also presented in Chapter Five is the role of avian influenza Endemic Outbreak Response Teams. When an avian influenza outbreak occurs, an Avian Influenza Outbreak Control Team should be set up immediately by the Outbreak Control Coordinator of the affected Health District. In practice, an Endemic Outbreak Response Team should be established before an outbreak
occurs. Members of the said team are normally performing their usual duties, but in the event of an outbreak of avian influenza, they come together to undertake special functions. The said team members must implement epidemiological investigations and control strategies with the coordination by relevant staff from the Provincial and National Departments of Health. Lastly discussed in Chapter Five was the place and role of environmental health in Avian Influenza Endemic Outbreak Response Teams from national, provincial, health district and health sub-district perspectives. It was found that the environmental health practitioners form part of Endemic Outbreak Response Teams at all spheres of government and plays a key role in epidemiological investigations and avian influenza control.

Recommendations

The work methods and - procedures for avian influenza surveillance and control as developed in this study provide numerous opportunities for further exploration. Recommendations include:

1. The education of all role-players on the disease and the training of environmental health practitioners on detailed work methods and - procedures for the surveillance and control of avian influenza.

2. The establishment of an effective avian influenza surveillance and control strategy within the Eastern Cape province. Effective surveillance can facilitate timely action for the control of an avian influenza outbreak. Without adequate surveillance, local health officials will not be able to understand the true scope of an avian influenza outbreak and may not recognize a new pandemic until many people have been affected.

3. Provincial Health Departments must encourage their respective municipalities to budget appropriately for strategies of avian influenza surveillance and control. Municipalities must address avian influenza preparedness plans as an integral part of their annual integrated development plans.
4. Liaison and communication networks need to be strengthened amongst all municipalities.

5. From the analysis of the organizational structure of the provincial sphere of government the deduction was made that the time it takes for information to reach the relevant member of the Provincial Executive Council of Health (MEC) is problematic. The official lines of communication are very time consuming. Communication systems should be developed that allows the Deputy-Director: Environmental Health to communicate pressing environmental health issues directly to the member of the executive council.

6. Unambiguous provincial guidelines need to be established for situations when emergencies arise.

7. From the analysis of the organizational structure of the national sphere of government it was found that the time it takes for information to reach the Minister of Health is problematic. The formal lines of communication are very time consuming. Communication systems should be developed that allow the Director: Environmental Health to communicate urgent environmental health information directly to the said Minister.

8. Clear national guidelines need to be established for situations when emergencies arise.
BIBLIOGRAPHY


INTERNET SOURCES CONSULTED


INTERVIEWS

Dr. U. Nagpal, Provincial Communicable Disease Outbreak Co-ordinator, KwaZulu-Natal, 15 December 2006.


Mr. A. Wild, Director: Environmental Health, Eastern Cape Provincial Health Department, 7 May 2007.

Mr. D. Bezana, Deputy Director: Environmental Health, Eastern Cape Provincial Health Department, 14 February 2007 and 10 June 2007.

Mr. M. Agenbag, Manager: Municipal Health Services, Ukhahlamba District Municipality, Eastern Cape Province, 12 April 2007.


Mr. S. Titus, Provincial Communicable Disease Outbreak Co-ordinator, Western Cape Province, 2 February 2007.

Mr. W. Ramkrishna, Assistant – Director: Emerging and Re-emerging Infectious Diseases, National Department of Health, 11 June 2007.

Mrs. A. Gouws, Provincial Communicable Disease Outbreak Co-ordinator, Mpumalanga, 7 December 2006.


Mrs. C. Sibideki, Provincial Communicable Disease Outbreak Co-ordinator, North- West Province, 21 December 2006.

Mrs L. Erasmus, Programme Manager: Health Information Business Unit, Nelson Mandela Metropolitan Municipality, 5 June 2007

Mrs. N. Crisp, Provincial Communicable Disease Outbreak Co-ordinator, Northern Cape, 23 January 2007.
ANNEXURE ONE

LETTER: REQUEST FOR PERMISSION TO CONDUCT TELEPHONIC INTERVIEWS:
EMPLOYERS OF THE PROVINCIAL COMMUNICABLE DISEASE OUTBREAK
CONTROL CO-ORDINATORS OF THE NINE PROVINCES IN SOUTH AFRICA

18 Marche Street
Rowallan Park
Port Elizabeth
6025
15 September 2006

The Head of Department
Department of Health
Eastern Cape / Western Cape / Northern Cape / KwaZulu - Natal / Gauteng / Limpopo /
Mpumalanga / Free State / North West - Province

Dear Sir / Madam

RESEARCH – M.TECH: ENVIRONMENTAL HEALTH – REQUEST TO CONDUCT A
TELEPHONIC INTERVIEW WITH THE PROVINCIAL COMMUNICABLE DISEASE
OUTBREAK CO-ORDINATOR REGARDING THE SURVEILLANCE AND CONTROL
OF AVIAN INFLUENZA.

I am currently registered at the Nelson Mandela Metropolitan University (NMMU) for a
Master’s Degree in Environmental Health. My dissertation is entitled “Environmental
Health work methods and - procedures for the surveillance and control of Avian
Influenza in the Eastern Cape province – South Africa”.

To enable me to effectively execute this study, I will need to conduct a telephonic
interview with the Provincial Communicable Disease Outbreak Co-ordinator within your
province. I would like to conduct the telephonic interviews during November 2006. The
duration of the interviews will be more or less twenty minutes. After permission is granted I will phone the said person to arrange for an appropriate time to conduct the interview. Dr. H.J. Maarschalk, the Head of the Department of Environmental Health at the NMMU, will be supervising the study and may be contacted at telephone number 041 – 504 3273 should you have any questions.

Your favourable consideration of this request would be appreciated.

Yours sincerely

Sammy Elie

M.Tech Environmental Health student
Cell phone: 082 6688 487
mwelies@telkomsa.net
ANNEXURE TWO

TELEPHONIC QUESTIONNAIRE SCHEDULE: THE PROVINCIAL COMMUNICABLE DISEASE OUTBREAK CONTROL CO-ORDINATORS OF THE NINE PROVINCES IN SOUTH AFRICA

Instructions: 1. Please make a cross in the boxes provided to indicate your selection.
               2. Please write your response in the spaces provided where required.

1. What is your gender?  [ ] Male  [ ] Female

2. What is your age?  [ ] yrs

3. How many years of experience do you have relevant to your current job?
   [ ] yrs  [ ] months

4. How many years have you been the Provincial Communicable Disease Outbreak Co-ordinator for your province?
   [ ] yrs  [ ] months

5. Have you been a Provincial Communicable Disease Outbreak Co-ordinator for another province?
   Yes  [ ]
   No  [ ]
6. If yes, for how long have you been the Provincial Communicable Disease Outbreak Co-ordinator for that province?

[ ] yrs [ ] months

7. What are your qualifications?

---------------------------------------------------------------------------------------------------------------------------------------

---------------------------------------------------------------------------------------------------------------------------------------

8. Did you receive any training regarding the coordination of an avian influenza outbreak?

---------------------------------------------------------------------------------------------------------------------------------------

9. How long was the training?

---------------------------------------------------------------------------------------------------------------------------------------

10. Who offered the training?

---------------------------------------------------------------------------------------------------------------------------------------

11. In which of the following languages can you communicate?

English [ ] Afrikaans [ ] IsiXhosa [ ] IsiZulu [ ]

IsiNdebele [ ] Northern Sotho [ ] Sesotho [ ]

Setswana [ ] SiSwati [ ] Tshivenda [ ] Xitsonga [ ]
Other □
If other, state the language(s).

------------------------------------------------------------------------------------------------------------

12. Does your province have a contingency plan to deal with an avian influenza outbreak?

Yes □
No □

13. If yes, how can I get access to your provincial avian influenza outbreak contingency plan?

------------------------------------------------------------------------------------------------------------

14. Please rate the level of preparedness of your province to deal with an avian influenza outbreak? Levels of preparedness are:

Poor □
Fair □
Good □
Excellent □
15. Do you think there is a need for a single set of environmental health work methods and - procedures for the surveillance and control of avian influenza in South Africa?

Yes [ ]

No [ ]

16. How important do you consider a contingency plan with detailed environmental health work methods and - procedures for the surveillance and control of avian influenza in your province?

High importance [ ]

Moderate importance [ ]

Low importance [ ]

No importance [ ]

17. Please indicate below the sectors at the provincial sphere that serves on the Communicable Disease Outbreak Response Team for the control of avian influenza.

<table>
<thead>
<tr>
<th>Sectors at the provincial sphere</th>
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</table>
18. Please indicate below the sectors at the municipal sphere that serves on the Communicable Disease Outbreak Response Team for the control of avian influenza.

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<thead>
<tr>
<th>Sectors at the municipal sphere</th>
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</table>

19. Please list below the sectors at provincial sphere responsible for epidemiological investigations for the surveillance and control of avian influenza.

<table>
<thead>
<tr>
<th>Sectors at the provincial sphere</th>
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</tbody>
</table>
20. Please list below the sectors at the municipal sphere responsible for epidemiological investigations for the surveillance and control of avian influenza.

<table>
<thead>
<tr>
<th>Sectors at the municipal sphere</th>
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</table>

21. Does your province have a specific plan in place to deal with waste resulting from infected and dead birds due to avian influenza contamination?

22. What is the place and function of your Communicable Outbreak Response Team regarding avian influenza?
23. Do you receive regular updates regarding avian influenza?

Yes [ ]

No [ ]

If yes, from whom?

-------------------------------------------------------------------------------

-------------------------------------------------------------------------------

24. How often do you receive updates regarding the disease?

Daily [ ]

Weekly [ ]

Monthly [ ]

Quarterly [ ]

Six monthly [ ]

Annually [ ]

Never [ ]
25. How often do you have meetings in your province to discuss the status of the disease?

- Daily
- Weekly
- Monthly
- Quarterly
- Six monthly
- Annually
- Never

26. Who are the people that attend the meetings?

-------------------------------------------------------------------------------------------------------------------------------

27. To whom does the Provincial Communicable Disease Outbreak Co-ordinator report to at provincial sphere?

-------------------------------------------------------------------------------------------------------------------------------

28. To whom does the Provincial Communicable Disease Outbreak Co-ordinator report to at national sphere?

-------------------------------------------------------------------------------------------------------------------------------
29. Do you have any comments or recommendations that you think can be useful in developing detailed environmental health work methods and procedures for the surveillance and control of avian influenza in your province?
ANNEXURE THREE

DATA ANALYSIS OF THE TELEPHONIC INTERVIEWS CONDUCTED AMONGST PROVINCIAL COMMUNICABLE DISEASE OUTBREAK CO-ORDINATORS (THE GROUP OF EXPERTS)*

1. Interview response rate

Table One below, reflects the total population of provincial communicable disease outbreak co-ordinators that were interviewed. The table reflects also the interview response rate.

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>TELEPHONIC INTERVIEW RESPONSE RATE</th>
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<tbody>
<tr>
<td>Total number of provincial communicable outbreak co-ordinators</td>
<td>Total number of provincial communicable disease co-ordinators interviewed</td>
</tr>
<tr>
<td>9</td>
<td>7</td>
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</table>

The seventy-eight percent (78%) response rate can be regarded as representative of all provincial communicable disease outbreak co-ordinators in South Africa. The deduction can thus be made that the responses of the above seven provincial communicable disease outbreak co-ordinators are a reflection of the current situation in South Africa regarding the arrangements for the surveillance and control of avian influenza.

2. Gender

One (1) of the seven (7) respondents was male. An analysis of the data reveals that 86% of the responds are female and 14% are male. The deduction can be made that the majority of provincial communicable disease outbreak co-ordinators in South Africa are female.
3. Age

Figure Four below, reflects the ages of the seven respondents.

![Figure 4: Age of the Respondents]

The average age of all the respondents was fifty (51) years. Only one (1) of the respondents was younger than fifty (50) years. Six (6) of the respondents were above fifty (50) years of age which is 86% of the provincial communicable disease outbreak co-ordinators. Except for one (1) respondent that is fifty six (56) years old, all the other provincial communicable disease outbreak co-ordinators were twelve (12) years or more from the official retirement age which is sixty five (65) years.

4. Years of experience relevant to current job.

Figure Five below is a graphical representation of the respondent years of experience relevant to their current jobs.
The average years of experience are twelve (12) years and two (2) months. Four (4) of the respondents have ten (10) and more years of experience relevant to their current jobs. Only one of the respondents has less than five (5) years experience.

5. Years of experience as provincial communicable disease outbreak co-ordinators for own province.

Figure Six below reflects the respondents years of experience as provincial communicable disease co-ordinators in their own provinces.
The average years of experience as provincial communicable disease co-ordinators are three (3) years and five (5) months. Two (2) of the respondents have five (5) to ten (10) years of experience as provincial communicable disease co-ordinators in their own province, while the other five (5) respondents have between one (1) month and four (4) years of experience. The deduction from the above is that most of the provincial communicable disease co-ordinators in South Africa have been appointed within the last five (5) years.

6. Experience as provincial communicable disease co-ordinators in another province.
None (0) of the respondents indicated that they had worked as provincial communicable disease co-ordinators for another province. All the respondents (7) indicated that they had been involved before as a communicable disease co-ordinator in either a health district, or at the National Department of Health.

7. Educational attainment
Five (5) of the respondents have a National Diploma in Nursing or Public Health which is 71% of the respondents. Four (4) of the respondents, have a Masters degree in Public Health. Three (3) of the respondents have a B.Cur. degree and one has a B.Sc. Hons. degree in Medicine. One (1) respondent has a MBChB degree. One (1) of the respondents has a National Diploma in Environmental Health. The deduction can thus be made that all the respondents have a level of educational attainment that equips them to participate effectively in this survey. A further deduction that can be made is that most (more than 50%) of the provincial communicable disease co-ordinators are from curative primary health care services. Figure Seven hereunder represents this information.
8. Language proficiency

All the respondents (100%) were able to communicate in English. Four (4) of the respondents were able to communicate in both Afrikaans and English, and one (1) in three (3) African languages. Two (2) can only communicate in English. Figure Eight below represents this information.
Two (2) of the respondents indicated that they can also communicate in languages other than the languages indicated in the graph above. One (1) speaks German and the other respondent speaks Hindi.

9. Training received by provincial communicable disease co-ordinators regarding the coordination of an avian influenza outbreak.

Table Two below reflects the training received regarding an avian influenza outbreak.

<table>
<thead>
<tr>
<th>TABLE 2</th>
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<tbody>
<tr>
<td>TRAINING RECEIVED BY PROVINCIAL COMMUNICABLE DISEASE CO-ORDINATORS ON THE CO-ORDINATION OF AN AVIAN INFLUENZA OUTBREAK</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>Total number of provincial communicable disease co-ordinators interviewed</td>
</tr>
<tr>
<td>7</td>
</tr>
</tbody>
</table>

From the above it can be deduced that two (2) of the Provincial Communicable Outbreak Co-ordinators did not receive training. This represents 29% of the said co-ordinators. The five (5) respondents that received training indicated that the training was provided by the National Institute for Communicable Diseases (NICD).


Six (6) (86%), of the respondents (7) indicated that they do have contingency plans in place to deal with an avian influenza outbreak. Figure Nine below indicates the presence of contingency plans in place to deal with an avian influenza outbreak.
As far as the availability of the above avian influenza contingency plans are concerned, four (4) of the five (5) provinces indicated that they can make available copies of their avian influenza contingency plans for the purpose of this study.

11. Levels of preparedness of provinces to deal with an avian influenza outbreak. From Figure Ten below it can be seen that 57% (4) of the provinces in South Africa indicated their level of preparedness to deal with an avian influenza outbreak can be regarded to be fair. Only one (1) province is confident (level good) about their preparedness level to deal with an avian influenza outbreak.
12. The need for a single set of environmental health work methods and – procedures for the surveillance and control of avian influenza in South Africa
All the respondents (7) (100%) indicated that there is a need to develop a single set of environmental health work methods and - procedures for the surveillance and control of avian influenza in South Africa.

13. The importance of a contingency plan with detailed environmental health work methods and - procedures for the surveillance and control of avian influenza in provinces
All seven (100%) of the respondents indicated that a contingency plan with detailed environmental health work methods and - procedures for the surveillance and control of avian influenza in a province must be considered as high importance.

14. The sectors that should serve on the Provincial Avian Influenza Outbreak Response Team
A list of all the sectors that should serve on a Provincial Avian Influenza Outbreak Response Team was compiled from the responses of all seven (7) respondents. The list is indicated in Annexure 32.

15. The sectors that should serve on a Municipal Avian Influenza Outbreak Response Team
A list of all the sectors that should serve on a Municipal Avian Influenza Outbreak Response Team was compiled from the responses of the 7 respondents (See indicated Section 5.5.3 in Chapter 5).

16. Sectors at the provincial sphere that should be responsible for epidemiological investigations
All the respondents indicated that the following sectors should be responsible for epidemiological investigations at the provincial sphere:

- Communicable Disease Control Unit;
- Clinical Care Unit;
• Surveillance Unit
• Epidemiology Unit;
• Environmental Health;
• Health Promotion Unit; and
• Department of Agriculture.

17. Sectors at the municipal sphere responsible for epidemiological investigations
The responses from the respondents to the above were similar to that in 1.16 above.

18. Plans in place by provinces to deal with waste resulting from infected and dead birds due to avian influenza
Four (4) (57%) of the respondents (7) are of the opinion that provinces should have a specific plan in place to deal with waste resulting from infected and dead birds due to avian influenza contamination.

19. The place and role of environmental health in an Avian Influenza Communicable Outbreak Response Team
The place and role of environmental health in the Communicable Outbreak Response Teams regarding avian influenza was discussed in section 5.5 of Chapter 5.

20. The receiving of regular updates regarding avian influenza
Six (6) of the seven (7) respondents indicated that they received regular updates regarding the diseases from the National Institute for Communicable Diseases (NICD). The seventh (7th) respondent indicated that her province received regular updates from both the NICD and the National Health Laboratory Services (NHLS).
21. The frequency of updates received regarding the disease.
Five (5) of the seven (7) respondents received updated information on a monthly basis from the National Institute for Communicable Diseases. One (1) of the seven (7) respondents received information from the National Institute for Communicable Diseases on a quarterly basis. One (1) of the respondents indicated that her province has never received any updates regarding avian influenza.

22. The people that attended the Provincial Communicable Disease Outbreak Response meetings.
All respondents (100%) indicated that the said meetings were attended by members of the provincial outbreak response teams.

23. The person to whom the Provincial Communicable Disease Outbreak Co-ordinator reports to at the provincial sphere
All the seven (7) 100% respondents indicated that the Provincial Communicable Disease Outbreak Co-ordinator reports to the person in charge of health services in their provinces which is either the Director of Health or the Head of the Department. The post description or designation for the said person differs from province to province.

24. The person to whom the Provincial Communicable Disease Outbreak Co-ordinator reports to at the national sphere.
All seven (7) 100% of the respondents indicated that they reported to the National Director of Communicable Disease Control (National CDC).

25. Other comments or recommendations that respondents thought to be useful in developing detailed environmental health work methods and procedures for the surveillance and control of avian influenza in the Eastern Cape province
The comments of the respondents are listed below:
- All seven (7) (100%) of the respondents indicated that there should be more training for members of outbreak response teams, especially for environmental health practitioners at the municipal sphere
• Two (2) of the respondents (7) indicated that the training should be of a practical nature and of the same standard throughout the country.
• One respondent indicated that the level of preparedness can be increased by a simulation of the actual preparedness plan.
• Avian influenza hygiene training of the public, especially of farm workers, should be done.

* Information obtained in this annexure was used in the development of work methods and procedures for the surveillance and control of avian influenza in the Eastern Cape province. All the work methods and procedures developed during this study were accepted by the Provincial Communicable Disease Outbreak Control Co-ordinators (group of experts) on 31 August 2008.
ANNEXURE FOUR

PERSONAL INTERVIEW SCHEDULE: MANAGERIAL AND LINE FUNCTION PERSONNEL FROM TWO OF THE SIX DISTRICT (CATEGORY C) MUNICIPALITIES AND THE ONLY METROPOLITAN (CATEGORY A) MUNICIPALITY IN THE EASTERN CAPE PROVINCE.

- What is the current organisational structure for environmental health service delivery in the NMMM / Ukhahlamba / Cacadu District Municipality?
- Which Unit / Section is responsible for avian influenza surveillance and control in the NMMM / Ukhahlamba / Cacadu District Municipality?
- What are the current organisational arrangements in response to avian influenza outbreaks in the NMMM / Ukhahlamba / Cacadu District Municipality?
- Which Unit / Section is responsible for the training of the environmental health practitioners regarding avian influenza surveillance and control in the NMMM / Ukhahlamba / Cacadu District Municipality?
- Which Unit / Section is responsible for educating the public regarding the disease in the NMMM / Ukhahlamba / Cacadu District Municipality?
- What is the level of communication between the NMMM / Ukhahlamba / Cacadu District Municipality and other municipalities in response to avian influenza surveillance and control?
- Do you have standardised report forms for avian influenza surveillance and control in the NMMM / Ukhahlamba / Cacadu District Municipality?
- What are the challenges of the NMMM / Ukhahlamba / Cacadu District Municipality to respond effectively and efficiently to an avian influenza outbreak?
LETTER: REQUEST FOR PERMISSION TO CONDUCT RESEARCH

18 Marche Street
Rowallan Park
Port Elizabeth
6025
15 September

The Municipal Manager

- Nelson Mandela Metropolitan Municipality
- Ukhahlamba District Municipality
- Cacadu District Municipality

Dear Sir

RESEARCH – M.TECH: ENVIRONMENTAL HEALTH – REQUEST TO INTERVIEW PERSONNEL RESPONSIBLE FOR COMMUNICABLE DISEASE CONTROL

I am currently registered at the Nelson Mandela Metropolitan University (NMMU) for a Master’s Degree in Environmental Health. My dissertation is entitled “Environmental Health work methods and procedures for the surveillance and control of avian influenza in the Eastern Cape province – South Africa”.

To enable me to effectively execute this study, I will need to visit the surveillance and control personnel responsible for communicable diseases within the Nelson Mandela Metropolitan Municipality / Ukhahlamba District Municipality / Cacadu District Municipality to conduct interviews on existing work methods and procedures. I would like to conduct the interviews during November 2006. The interviews should not take more than half an hour. Dr. H.J. Maarschalk, the Head of the Department of
Environmental Health at the NMMU, will be supervising the study and may be contacted at telephone number 041 – 504 3273 should you have any questions.

Your favourable consideration of this request would be appreciated.

Yours sincerely

Sammy Elie

M.Tech Environmental Health student
Cell phone: 082 6688 487
mwelies@telkomsa.net
ANNEXURE SIX

INFORMATION AND INFORMED CONSENT FORM:
MANAGERIAL AND LINE FUNCTION PERSONNEL FROM TWO OF THE SIX DISTRICT (CATEGORY C) MUNICIPALITIES, THE ONLY METROPOLITAN (CATEGORY A) MUNICIPALITY IN THE EASTERN CAPE PROVINCE AND THE PROVINCIAL COMMUNICABLE DISEASE OUTBREAK CO-ORDINATORS (GROUP OF EXPERTS)

TITLE OF THE RESEARCH PROJECT:

Environmental health work methods and procedures for the surveillance and control of avian influenza in the Eastern Cape province - South Africa.

PRINCIPAL INVESTIGATOR: Sammy Abraham Elie

STUDENT NUMBER: 20380839

ADDRESS: 18 March Street
Rowallan Park
Port Elizabeth
6025

CONTACT CELL PHONE NO.: 082 66 88 487

DECLARATION BY PARTICIPANT:

I, the undersigned, ......................................................... (name)
[I.D. No:..........................] the participant, in my capacity as environmental health practitioner hereby confirm as follows:

Initial
1. I, the participant, was invited to participate in the above mentioned research project which is being undertaken by Mr. Sammy Elie, a student of the Department of Environmental Health of the Nelson Mandela Metropolitan University in Port Elizabeth.

2. The following aspects have been explained to me, the participant:

<table>
<thead>
<tr>
<th>Aim: The investigator is undertaking this study to develop a standardised set of environmental health work methods and - procedures which should contribute to effective avian influenza surveillance and control in the Eastern Cape province.</th>
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<tbody>
<tr>
<td>I understand the:</td>
</tr>
<tr>
<td><strong>Risks:</strong> There are no risks involved in the research study. The researcher will ensure that the participants are not subjected to any harm.</td>
</tr>
<tr>
<td><strong>Possible benefits:</strong> As a result of my participation in this study, I will contribute to a body of knowledge that will assist the researcher in developing a standardised set of environmental health work methods and - procedures which may contribute to effective avian influenza surveillance and control in the Eastern Cape province.</td>
</tr>
<tr>
<td><strong>Confidentiality:</strong> My identity will not be revealed in any discussion, description or scientific publications by the investigator.</td>
</tr>
<tr>
<td><strong>Access to findings:</strong> Any new information / benefit that develop during the course of the study will be shared with me by the principal investigator.</td>
</tr>
<tr>
<td><strong>Voluntary participation / refusal / discontinuation:</strong> My participation is voluntary. I reserve the right to refuse or discontinue to</td>
</tr>
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</table>
participate at any stage.

3. The information above was explained to me, the participant by Sammy Abraham Elie (ID. No. …………………………………..) in ………………………………… and I am in command of this language.

4. No pressure was exerted on me to consent to participation and I understand that I may withdraw at any stage without penalization.

5. Participation in this study will not result in any additional cost to myself.

I AM A VOLUNTARY PARTICIPANT IN THE ABOVEMENTIONED PROJECT.

Signed at ……………………………………… on……………………………………

(place) (date)

…………………………

Signature of participant

Source: Adapted from Nelson Mandela Metropolitan University (2005).
ANNEXURE SEVEN

ORGANOGRAM OF THE NATIONAL DEPARTMENT OF HEALTH
Clusters and their divisions

Deputy Director-General: Health Service Delivery

- Health Economics
  - Social Health Insurance
  - Public Private Partnerships
  - Health Financial Planning and Economics

- Hospital Services
  - Facilities Planning
  - Hospital Management
  - Emergency Medical Services
  - Revitalization Project

- Primary Health Care, District & Development
  - *Environmental Health*
  - Health Promotion
  - District & Development
  - Integrated Primary Health Care

- Health Information, Evaluation, Epidemiology and Research
  - National Health Information Systems
  - Epidemiology and Surveillance
  - Health Systems Research
  - Monitoring and Evaluation

- Non-Communicable Disease
  - Chronic Diseases, Disabilities and Geriatrics
  - Mental Health & Substance Abuse
  - Oral Health
  - Forensic Pathology Services [including Forensic Laboratory Services]
  - Forensic Chemistry Laboratories

- Office of Standards Compliance
  - Radiation Control
  - Quality Assurance

Source: Adapted from National Department of Health (2007).
ANNEXURE EIGHT

LIST OF MATTERS THAT THE PROVINCIAL LEGISLATURE SHARES
CONCURRENT POWERS WITH PARLIAMENT

Part A

- Administration of indigenous forests;
- Agriculture;
- Airports other than international and national airports;
- Animal control and diseases;
- Casinos, racing, gambling and wagering, excluding lotteries and sports pools;
- Consumer protection;
- Cultural matters;
- Disaster management;
- Education at all levels, excluding tertiary education;
- Environment;
- Health services;
- Housing;
- Indigenous law and customary law, subject to Chapter 12 of the Constitution;
- Industrial promotion;
- Language policy and the regulation of official languages to the extent that the provisions of Section 6 of the Constitution expressly confer upon the provincial legislatures legislative competence;
- Media services directly controlled or provided by the provincial government, subject to section 192 of the Constitution;
- Nature conservation, excluding national parks, national botanical gardens and marine resources;
- Police to the extent that the provisions of Chapter 11 of the Constitution confer upon the provincial legislatures legislative competence;
- Pollution control;
- Population development;
- Property transfer fees;
• Provincial public enterprises in respect of the functional areas in Schedule and Schedule 5 of the Constitution;
• Public transport;
• Public works, only in respect of the needs of provincial government departments in the discharge of their responsibilities to administer functions specifically assigned to them in terms of the Constitution or any other law;
• Regional planning and development;
• Road traffic regulation;
• Soil conservation;
• Tourism;
• Trade;
• Traditional leadership, subject to Chapter 12 of the Constitution;
• Urban and rural development;
• Vehicle licensing; and
• Welfare services.

Part B

The following local government matters to the extent set out in section 155(6) (a) and (7) of the Constitution:

• Air pollution;
• Building regulations;
• Child care facilities;
• Electricity and gas reticulation;
• Firefighting services;
• Local tourism;
• Municipal airports;
• Municipal planning;
• Municipal health services;
• Municipal public transport;
• Municipal public works, only in respect of the needs of municipalities in the
discharge of their responsibilities to administer functions specifically assigned to
them under the Constitution or any other law;
• Pontoons, ferries, jetties, piers and harbours, excluding the regulation of
international and national shipping and matters related thereto;
• Stormwater management systems in built-up areas;
• Trading regulations; and
• Water and sanitation services limited to potable water supply systems and
domestic waste-water and sewage disposal systems.

Source: Schedule 4 of the Constitution of the Republic of South Africa Act, 1996 (Act
ANNEXURE NINE

ORGANOGRAM OF THE EASTERN CAPE PROVINCIAL HEALTH DEPARTMENT

Source: Eastern Cape Department of Health (2007).
ANNEXURE TEN
ORGANIZATIONAL STRUCTURE OF UKHAHLAMBA DISTRICT MUNICIPALITY

ANNEXURE ELEVEN

DIAGRAM THAT ILLUSTRATES THE EVENTS DURING AN ANTIGENIC SHIFT

The genetic change that enables a flu strain to jump from one animal species to another, including humans, is called "ANTIGENIC SHIFT." Antigenic shift can happen in three ways:

A.1 A duck or other aquatic bird passes a bird strain of influenza A to an intermediate host such as a chicken or pig.

A.2 A person passes a human strain of influenza A to the same chicken or pig. (Note that reassortment can occur in a person who is infected with two flu strains.)

A.3 When the viruses infect the same cell, the genes from the bird strain mix with genes from the human strain to yield a new strain.

A.4 The new strain can spread from the intermediate host to humans.

The new strain may further evolve to spread from person to person. If so, a flu pandemic could arise.
Each year’s flu vaccine contains three flu strains—two A strains and one B strain—that can change from year to year.

After vaccination, your body produces infection-fighting antibodies against the three flu strains in the vaccine.

If you are exposed to any of the three flu strains during the flu season, the antibodies will latch onto the virus’s HA antigens, preventing the flu virus from attaching to healthy cells and infecting them.

Influenza virus genes, made of RNA, are more prone to mutations than genes made of DNA.

If the HA gene changes, so can the antigen that it encodes, causing it to change shape.

If the HA antigen changes shape, antibodies that normally would match up to it no longer can, allowing the newly mutated virus to infect the body’s cells.

This type of genetic mutation is called “ANTIGENIC DRIFT.”

Source: Adopted from National Institute of Allergy and Infectious Diseases (2007)
ANNEXURE 12

INSTANCES OF AVIAN INFLUENZA INFECTIONS IN HUMANS: 1997-2006

Confirmed instances of avian influenza viruses infecting humans since 1997 to 2006 include:

- **H5N1, Hong Kong, Special Administrative Region, 1997:** Highly pathogenic avian influenza A (H5N1) infections occurred in both poultry and humans. This was the first time an avian influenza A virus transmission directly from birds to humans had been found. During this outbreak, 18 people were hospitalized and six of them died. To control the outbreak, authorities killed about 1.5 million chickens to remove the source of the virus. Scientists determined that the virus spread primarily from birds to humans, though rare person-to-person infection was noted.

- **H9N2, China and Hong Kong, Special Administrative Region, 1999:** Low pathogenic avian influenza A (H9N2) virus infection was confirmed in two children and resulted in an uncomplicated influenza-like illness. Both patients recovered, and no additional cases were confirmed. The source is unknown, but the evidence suggested that poultry was the source of infection and the main mode of transmission was from bird to human. The possibility of person-to-person transmission could not be ruled out. Several additional human H9N2 infections were reported from China in 1998-99.

- **H7N2, Virginia, 2002:** Following an outbreak of H7N2 among poultry in the Shenandoah Valley poultry production area, one person was found to have serologic evidence of infection with H7N2.

- **H5N1, China and Hong Kong, Special Administrative Region, 2003:** Two cases of highly pathogenic avian influenza A (H5N1) infection occurred among members of a Hong Kong family that had traveled to China. One person recovered, the other died. How or where these two family members were infected was not determined. Another family member died of a respiratory illness in China, but no testing was done.
• **H7N7, Netherlands, 2003**: The Netherlands reported outbreaks of influenza A (H7N7) in poultry on several farms. Later, infections were reported among pigs and humans. In total, 89 people were confirmed to have H7N7 influenza virus infection associated with this poultry outbreak. These cases occurred mostly among poultry workers. H7N7-associated illness included 78 cases of conjunctivitis (eye infections); 5 cases of conjunctivitis and influenza-like illnesses with cough, fever, and muscle aches; 2 cases of influenza-like illness; and 4 cases that were classified as “other.” There was one death among the 89 total cases. It occurred in a veterinarian who visited one of the affected farms and developed acute respiratory distress syndrome and complications related to H7N7 infection. The majority of these cases occurred as a result of direct contact with infected poultry; Dutch authorities reported three possible instances of transmission from poultry workers to family members. Since then, no other instances of H7N7 infection among humans have been reported.

• **H9N2, Hong Kong, Special Administrative Region, 2003**: Low pathogenic avian influenza A (H9N2) infection was confirmed in a child in Hong Kong. The child was hospitalized and recovered.

• **H7N2, New York, 2003**: In November 2003, a patient with serious underlying medical conditions was admitted to a hospital in New York with respiratory symptoms. One of the initial laboratory tests identified an influenza A virus that was thought to be H1N1. The patient recovered and went home after a few weeks. Subsequent confirmatory tests conducted in March 2004 showed that the patient had been infected with avian influenza A (H7N2) virus.

• **H7N3, Canada, 2004**: In February 2004, human infections of highly pathogenic avian influenza A (H7N3) among poultry workers were associated with an H7N3 outbreak among poultry. The H7N3-associated, mild illnesses consisted of eye infections.

• **H5N1, Thailand and Vietnam, 2004**: In late 2003, outbreaks of highly pathogenic influenza A (H5N1) in poultry in Asia were first reported by the World Health Organization. Human infections with H5N1 were reported
beginning in 2004, mostly resulting from contact with infected poultry. In Thailand one instance of probable human-to-human spread is thought to have occurred.

- **H5N1, Cambodia, China, Indonesia, Thailand and Vietnam, 2005**: Human infections with H5N1 occurred in association with the ongoing H5N1 epizootic in the region. At least two persons in Vietnam were thought to have been infected through consumption of uncooked duck blood.

- **H5N1, Azerbaijan, Cambodia, China, Djibouti, Egypt, Indonesia, Iraq, Thailand, Turkey, 2006**: Human infections with H5N1 occurred in association with the ongoing and expanding epizootic. While most of these cases occurred as a result of contact with infected poultry, in Azerbaijan, the most plausible cause of exposure to H5N1 in several instances of human infection was thought to be contact with infected dead wild birds (swans).

ANNEXURE 13

MAP OF AREAS WITH CONFIRMED HUMAN CASES OF H5N1 AVIAN INFLUENZA SINCE 2003

ANNEXURE 14

MAP OF AREAS REPORTING CONFIRMED OCCURRENCE OF H5N1 AVIAN INFLUENZA IN POULTRY AND WILD BIRDS SINCE 2003

For international planning purposes, the World Health Organization has defined phases in the progression of an influenza pandemic from the first emergence of a novel influenza virus, to its wide international spread. These phases allow a stepwise escalating approach to preparedness planning and response. They are global classifications based on the overall international situation and are used internationally for planning purposes. Table Three below, reflects the phases of pandemic influenza.

<table>
<thead>
<tr>
<th>PHASE</th>
<th>PERIODS</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTER-PANDEMIC PHASE</td>
<td>1</td>
<td>Low risk of human cases</td>
</tr>
<tr>
<td>(New virus in animals, no human cases)</td>
<td>2</td>
<td>Higher risk of human cases</td>
</tr>
<tr>
<td>PANDEMIC ALERT PHASE</td>
<td>3</td>
<td>No or very limited human-to-human transmission</td>
</tr>
<tr>
<td>(New virus causes human disease)</td>
<td>4</td>
<td>Evidence of increased human-to-human transmission</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Evidence of significant human-to-human transmission</td>
</tr>
<tr>
<td>PANDEMIC PHASE</td>
<td>6</td>
<td>Efficient and sustained human-to-human transmission</td>
</tr>
</tbody>
</table>

**A. Interpandemic phase**

- **Period 1**
  No new influenza virus subtypes have been detected in humans. An influenza virus subtype that has caused human infection may be present in animals. If present in animals, the risk of human infection or disease is considered to be low.

  Strengthen influenza pandemic preparedness at the global, regional, national and sub-national levels.
• **Period 2**
No new influenza virus subtypes have been detected in humans. However, a circulating animal influenza virus subtype poses a substantial risk of human disease.

Minimize the risk of transmission to humans; detect and report such transmission rapidly if it occurs.

**B. Pandemic Alert Phase**

• **Period 3**
Human infection(s) with a new subtype, but no human-to-human spread, or at most rare instances of spread to a close contact.

Ensure rapid characterization of the new virus subtype and early detection, notification and response to additional cases.

• **Period 4**
Small cluster(s) with limited human-to-human transmission, but spread is highly localized, suggesting that the virus is not well adapted to humans.

Contain the new virus within limited foci or delay spread to gain time to implement preparedness measures, including vaccine development.

• **Period 5**
Larger cluster(s) but human-to-human spread still localized, suggesting that the virus is becoming increasingly better adapted to humans, but may not yet be fully transmissible (substantial pandemic risk).

Maximize efforts to contain or delay spread, to possibly avert a pandemic, and to gain time to implement pandemic response measures.

**C. Pandemic Phase**

• **Period 6**
Pandemic: increased and sustained transmission in general population.
Minimize the impact of the pandemic.

The distinction between Period 1 and Period 2 is based on the risk of human infection or disease resulting from circulating strains in animals. The distinction is based on various factors and their relative importance according to current scientific knowledge. Factors may include pathogenicity in animals and humans, occurrence in domesticated animals and livestock or only in wildlife, whether the virus is enzootic or epizootic, geographically localized or widespread, and/or other scientific parameters. The distinction between Period 3, Period 4 and Period 5 is based on an assessment of the risk of a pandemic. Various factors and their relative importance according to current scientific knowledge may be considered. Factors may include the rate of transmission, geographical location and spread, severity of illness, presence of genes from human strains (if derived from an animal strain), and/or other scientific parameters.

Source: Adapted from World Health Organization (2006e).
CLINICAL FEATURES OF HUMAN AVIAN INFLUENZA*

1. Clinical Features
The clinical spectrum of influenza A (H5N1) in humans is based on descriptions of hospitalised patients. The frequency of milder illnesses, sub-clinical infections and atypical presentations like encephalopathy and gastroenteritis have not been determined, but case reports indicate that each occurs.

i) Incubation period:
The incubation period (IP) for classic human influenza viruses is 2–3 days (range 1–7 days). The incubation period of human influenza A (H5N1) is currently uncertain but may be longer. Current data indicate an IP ranging from 2 - 8 days and possibly as long as 17 days. The current World Health Organization recommendation of 7 days is useful for field investigations and the monitoring of patient contacts.

ii) Symptoms:
High fever (≥ 38°C) and influenza like illness (muscle pains, malaise, sore throat) with lower respiratory tract symptoms like cough and shortness of breath are the usual initial presenting features. Although uncommon, watery diarrhoea without blood or inflammatory changes appears to be more common than in classic human influenza A and may precede respiratory symptoms by up to one week. Other less common initial symptoms reported include vomiting, abdominal pain, pleuritic pain, bleeding from nose and gums and encephalopathy.

iii) Signs:
The patient may be tachypnoeic and may have inspiratory crackles present on auscultation of the chest. Sputum production is variable and may even be bloody.

iv) Chest X-ray changes:
Almost all patients have clinical apparent primary viral pneumonia and although radiographic changes are non-specific, they may include diffuse, multifocal or patchy infiltrates, interstitial infiltrates’ segmental or lobular consolidation with air bronchograms.
Radiographic changes are present on average 7 days after the onset of symptoms in most patients.

v) **Common laboratory findings:**
- Lymphopenia (<1 x 10^9/litre); and
- Mild to moderately raised aminotransferase levels may occur.

vi) **Clinical course:**
The illness rapidly progresses to respiratory distress and respiratory failure within one week of the onset of symptoms. Multi-organ failure, including renal failure and cardiac compromise are common. Death occurs on average 9-10 days after the onset of symptoms and most patients die due to respiratory failure. Mortality rate in hospitalized patients is high (±50%), despite adequate ventilatory support. The mortality rate in those younger than 15 years old in Thailand was 89%.

vii) **General considerations:**
Early recognition of cases is confounded by the non-specificity of the initial symptoms and high rates of acute respiratory illnesses from other causes. It remains important to include the diagnosis of H5N1 infection in the differential diagnosis of patients presenting with severe acute respiratory illness, especially in countries where highly pathogenic avian influenza viruses have been identified as a cause of illness in animal populations.

* In developing the clinical features of human avian influenza in this annexure the resources listed below were consulted. The clinical features for human avian influenza were confirmed by the Provincial Communicable Disease Outbreak Control Co-ordinators (group of experts) on 31 August 2008.

ACTIVE SCREENING PROCESS FOR HUMAN AVIAN INFLUENZA CASES

Screening questions to be asked of patients as part of an active screening for avian influenza are listed below.

Question 1: Do you have new / a worse cough or shortness of breath?
  • if ‘no’, stop here (no further questions)
  • if ‘yes’, continue with next question

Question 2: Are you feeling feverish, have you had shakes or chills in the last 24 hours?
  • if ‘no’, take temperature; if >38 °C, continue with next question, otherwise stop (no further questions)
  • if yes, take temperature and continue with next question.

• Initiate droplet precautions if “yes” to question one and question two.
• if ‘no’, take temperature; if higher than 38 °C, continue with next question, otherwise stop (no further questions).

Question 3: Is any of the following true?
  • Have you lived in or visited China, Taiwan, Hong Kong, Indonesia, Thailand or Viet Nam within the last 30 days?

• For updates on affected countries visit: www.who.int/csr/disease/avian_influenza/en/ or http://www.oie.int/eng/en_index.htm

Question 4: Have you had any contact in the last 30 days with a sick person who has travelled to these areas?
• Patients with fever and respiratory symptoms and answered ‘yes’ to any of these exposures / conditions may potentially have severe respiratory illness.
• Initiate droplet precautions and notify infection control if “yes” to 1, 2 and 3.
• Infection control to notify the public health authority.

Additional questions to be asked of all admitted patients:

Question 4: Do you work for a health care agency or organization?

Question 5: Are you a resident of a long-term care institution?

• Initiate droplet precautions and notify local health authority if “yes” to questions 1, 2 and either 4 or 5.
• The local health authority must notify the health district authority.

• Droplet precautions:
Droplet precautions include the use of surgical masks and eye protection or face shields on the part of health care workers when encountering patients who have respiratory infections, especially if associated with coughing or sneezing. Transmission is principally by large respiratory droplets particularly when within one metre of such a patient. Surgical masks are also used where appropriate to protect the mucous membranes of the eyes, nose and mouth of the health care worker during patient care activities likely to generate splashes or sprays of blood, body fluids, secretions or excretions (e.g., airway suctioning).

Source: Adapted from Canadian Ministry of Health (2003) and confirmed by the Provincial Communicable Disease Outbreak Control Co-ordinators (group of experts) on 31 August 2008.
INITIAL DIAGNOSIS FORM FOR NOTIFIABLE DISEASES: FORM (GW 17/5)

Notification of medical condition
(Section 32, 47 of Act 63 of 1977)
Department of National Health
Please print: Where appropriate, mark the correct box with a cross (x)
Complete in duplicate. Original to be sent to local authority where patient was
diagnosed:
Copy to remain in book

DETAILS OF PATIENT

<table>
<thead>
<tr>
<th>Surname</th>
<th>First Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Sex</td>
</tr>
<tr>
<td></td>
<td>Male ☐</td>
</tr>
<tr>
<td></td>
<td>Female ☐</td>
</tr>
<tr>
<td>Ethnic Group</td>
<td>Asian ☐</td>
</tr>
<tr>
<td></td>
<td>Coloured ☐</td>
</tr>
<tr>
<td></td>
<td>Back ☐</td>
</tr>
<tr>
<td></td>
<td>White ☐</td>
</tr>
</tbody>
</table>

Residential address:
Telephone no.:

DETAILS OF MEDICAL CONDITION

Medical condition:
Date of onset: DD / MM / YY
Date of death (if applicable): DD / MM / YY
Possible place of infection:
Diagnosis was based on:
Clinical history and examination only ☐
Clinical and other investigations ☐

RESULTS OF INVESTIGATIONS

<table>
<thead>
<tr>
<th>Investigation</th>
<th>Results</th>
</tr>
</thead>
</table>

REFERRED TO

Name of hospital or clinic:
Patient registration number: Date of admission: DD / MM / YY

NOTIFIED BY

Name:
Address:
Tel. no.:
Profession: Medical practitioner ☐ Other ☐
Nurse ☐
Signature: Date: DD / MM / YY

Source: Adapted from Health Systems Trust (1998) and confirmed by the Provincial
Communicable Disease Outbreak Control Co-ordinators (group of experts) on 31 August
2008.
## HUMAN AVIAN INFLUENZA NOTIFICATION FORM

<table>
<thead>
<tr>
<th>INFORMATION OF REPORTING HEALTH FACILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of reporting health facility:</td>
</tr>
<tr>
<td>Health district:</td>
</tr>
<tr>
<td>Address of the health facility:</td>
</tr>
<tr>
<td>Telephone of health facility:</td>
</tr>
<tr>
<td>Fax of health facility:</td>
</tr>
<tr>
<td>Name of reporter, Job title, Telephone:</td>
</tr>
<tr>
<td>Name and telephone of person who clinically confirmed the case:</td>
</tr>
<tr>
<td>Confirmed laboratory:</td>
</tr>
<tr>
<td>Telephone of confirmed laboratory:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DETAILS OF PATIENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of patient:</td>
</tr>
<tr>
<td>Address of patient:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CLINICAL DATA OF PATIENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptoms on day of onset :</td>
</tr>
<tr>
<td>Days of illness before initial presentation:</td>
</tr>
<tr>
<td>Onset of illness during antiviral prophylaxis :</td>
</tr>
<tr>
<td>Hospitalization, including first date of admission and duration:</td>
</tr>
<tr>
<td>Pre-existing conditions:</td>
</tr>
<tr>
<td>Additional comments, (e.g. exposure history to confirmed human and animal cases etc):</td>
</tr>
<tr>
<td>Signature:</td>
</tr>
<tr>
<td>Date: DD / MM / YY</td>
</tr>
</tbody>
</table>

Source: Own research findings and confirmed by the Provincial Communicable Disease Outbreak Control Co-ordinators (group of experts) on 31 August 2008.
ANNEXURE 20

WORK METHODS AND - PROCEDURES FOR HUMAN AVIAN INFLUENZA
SPECIMEN COLLECTION*

1. **The number of specimens required**
   - For each type of specimen two specimens should be taken in separate specimen tubes each occasion that sampling is undertaken. One can be used for immediate analysis and the other retained for reference purposes, retesting, etc.
   - Each patient specimen must be assigned a unique identification number and accompanied by a data collection form (see Section 14 of Annexure 20).
   - This identification number should be used on all documentation concerning the specimen from that source.

2. **The type of specimens to collect from suspect cases**
   - Specimens for diagnosis of suspect cases of human avian influenza A (H5N1) can be collected from the:
     - Upper respiratory tract;
     - Lower respiratory tract; and
     - Blood.

These are listed and discussed below. Firstly discussed are the upper respiratory tract samples.

**Upper respiratory tract samples**

- Throat swabs (posterior-pharyngeal ) are the preferred upper respiratory tract specimen for detecting A(H5N1);
- Nasal swabs with nasal secretions (from the anterior turbinate area) or nasopharyngeal aspirates or swabs are also appropriate specimens.

A swab collected from each nostril, and a throat swab pooled into the same container of viral transport medium is the specimen of choice. Sampling from the respiratory tract is hazardous as the operator is very close to the patient (Fig. 11).
3. Performing a posterior pharyngeal swab (throat swab)
   • Hold the tongue out of the way with a tongue depressor;
   • Use a sweeping motion to swab the posterior pharyngeal wall and tonsilar pillars. Have the subject say "aahh" to elevate the uvula. Avoid swabbing the soft palate and do not touch the tongue with the swab tip as this can induce the gag reflex;
   • Put the swab into viral transport medium.

![FIGURE 11: TAKING OF A THROAT SAMPLE](the operator is close to the patient)

Source: Adapted from the World Health Organization (2006b).

• The above sampling procedures can generate aerosols and droplets. Full personal protective equipment is therefore essential and the correct swab techniques must be adhered to as illustrated in Figure 12 below.
4. Performing nasopharyngeal swabs
- Nasopharyngeal swabs may be collected instead of nose and throat swabs. Swabs pose a lower risk of infection of staff than do nasopharyngeal aspirates (NPA) or nasal washes, both of which may generate aerosols. They are suitable for testing by polymerase chain reaction (PCR) which is a rapid, sensitive laboratory test.
  - Insert a flexible, fine-shafted polyester swab into the nostril and back to the nasopharynx.
  - The swab should be slid straight into the nostril with the patient’s head held slightly back (Fig. 3). The swab is inserted following the base of the nostril towards the auditory pit and will need to be inserted at least 5–6 cm in adults to ensure that it reaches the posterior pharynx. Do not use rigid shafted swabs for this sampling method —a flexible shafted swab is essential.
• Leave the swab in place for a few seconds.
• Withdraw slowly with a rotating motion.
• Put the swab into viral transport medium.
• A second swab should be used for the other nostril and put into a second tube. This can serve as the second sample from the patient.
• Note: Nasopharyngeal sampling is an invasive process that can cause considerable distress to the patient.

**FIGURE 13:**

TAKING A NASOPHARYNGEAL SWAB

Source: Adapted from the World Health Organization (2006b).

5. **Performing a nasopharyngeal aspirate**
   • A nasopharyngeal aspirate is an easier and safer swab procedure for infants and young children.
   • Use an aspiration trap. Insert silicon catheter in the nostril towards the auditory pit and aspirate secretion gently by suction (Fig. 14).
6. **Anterior nasal swab**
   - Use the same type of rigid swab as for sampling from the throat. Advance the swab tip past the vestibule (anterior nares) to the nasal mucosa (approximately 2–3 cm from the nostrils in adults).
   - Gently rotate to collect nasal secretions from the anterior portions of the turbinate and septal mucosa (Fig. 15).

**FIGURE 14:**
NASOPHARYNGEAL ASPIRATION

**FIGURE 15:**
ANTERIAL NASAL SWAB

Source: Adapted from the World Health Organization (2006b).
7. Lower respiratory tract
   - In addition to swabs from the upper respiratory tract, invasive procedures such as bronchoalveolar lavage or a lung biopsy can be performed for the diagnosis of virus infections of the lower respiratory tract where clinically indicated. If the patient is intubated, take a tracheal aspirate or collect a sample during bronchoalveolar lavage. Post mortem samples may also be submitted. In all cases these procedures must be performed within a controlled environment using suitable respiratory precautions.

8. Special precautions required when collecting blood specimens
   - Standard precautions should always be observed when taking and handling blood specimens because the patient may be infected with a blood – born pathogen (for example HIV or Hepatitis B).
   - Use personal protective equipment — at least gloves; plus face-shields, masks and gowns if splashes are anticipated.
   - Remove and discard personal protective equipment items immediately after completion of the task.
   - Perform hand hygiene every time gloves are removed.
   - An acute-phase serum specimen (7-10 ml clotted blood) should be taken soon after onset of symptoms (not later than seven days). A convalescent-phase serum specimen should also be collected 14 days after the onset of symptoms to demonstrate seroconversion. Where patients are near death, a second ante-mortem specimen should be collected even if 14 days has not elapsed.

9. Taking of a blood specimen
   - Label the tubes, including the unique patient identification number, using an indelible marker pen.
   - Always check to ensure that the correct tubes are used for each patient.
   - Place a tourniquet above the venepuncture site, palpate and locate the vein (Fig. 16).
• Disinfect the venepuncture site meticulously with 70% isopropyl alcohol (an alcohol swab) or 10% polyvidone iodine by swabbing the skin concentrically from the centre of the venepuncture site outwards (Fig. 17).

Source: Adapted from the World Health Organization (2006b).
• Let the disinfectant evaporate.
• Do not re-palpate the vein.
• Performing a venepuncture. (Fig. 18)
• If withdrawing blood with conventional disposable syringes, withdraw 3–5 ml of whole blood from adults and older children and 1ml from infants.
• Under asepsis, transfer the specimen to appropriate transport tubes.
• Secure caps tightly.
• If withdrawing blood with a vacuum system (e.g. Vacutainer), withdraw the desired amount of blood directly into each transport tube (Fig 19).

**FIGURE 18:** Performing a venepuncture with venepuncture system  
**FIGURE 19:** Drawing blood into a Vacutainer serum-separator tube  
**FIGURE 20:** Applying pressure to the venepuncture site

Source: Adapted from the World Health Organization (2006b).

• Remove the tourniquet. Use a cotton swab to apply pressure to the venepuncture site until bleeding stops (Fig. 20) and apply a band-aid.
• Never recap used sharps.
• Discard directly into a suitable container (a proper sharps disposal container if available or a container such as a coffee cup or other metal can which should be appropriately labelled before use).
• Recheck that the tubes used for sampling have been correctly labelled.
• After taking all the samples, complete the appropriate field data sheets or case investigation forms and the required laboratory request forms using the same identification numbers used on the tubes.
10. Secondary specimens (these are not essential but can be useful if materials are available)
   - Use plasma in ethylenediaminetetraacetic acid (for detection of viral RNA).
   - Rectal swab — especially if the patient has diarrhea
   - Spinal fluid if meningitis is suspected and a spinal tap is to be performed for diagnostic/therapeutic purposes.

11. Storing specimens
   - Repeated freezing and thawing of specimens must be avoided to prevent loss of infectivity.
   - Note that certain types of freezer are designated "frost free" and these should not be used for specimen storage as the temperature cycling involved in keeping them free of ice accumulation can damage specimens.
   - If specimens in viral transport medium (or blood sera/plasma) for viral isolation can be taken to the laboratory within four days, they may be kept at +4 °C.
   - Freezing at -20 °C is not recommended because the virus does not survive well at this temperature, particularly in frost-free freezers.
   - In the absence of freezers (or of viral transport medium), ethanol-preserved swabs are a possible alternative.
   - Storage of such specimens at +4 °C (in a standard refrigerator) is better than at room temperature.
   - Blood serum samples should be frozen at -70 °C for polymerase chain reactions and at -20 °C or lower for antibody determination but they can be stored at +4 °C for approximately one week.
   - Specimens for influenza virus isolation should not be stored or transported in dry ice (solid carbon dioxide) unless they are sealed in glass or sealed, taped and double plastic-bagged.
   - Carbon dioxide can rapidly inactivate influenza viruses if it gains access to the specimens.
   - (Note: Take care not to place dry ice in a hermetically sealed container as it could cause an explosion).
12. Monitoring of medical or surveillance personnel
   • If an incident that could lead to infection occurs during a sampling procedure (such as a breakdown of protective procedures) the staff member(s) involved should be monitored for signs of illness for a week (including daily temperature measurement).
   • Post-exposure chemoprophylaxis with a neuraminidase inhibitor for 5 to 10 days is a consideration under such circumstances.
   • All staff working with human or animal cases of avian influenza should monitor their own health (see Annexure 23 for avian influenza-like illness monitoring form) and any evidence of influenza-like illness within ten days of exposure to a confirmed or suspected human case or to a potential avian source should be viewed as suspected avian influenza and treated appropriately by a medical doctor.

13. Packaging of specimens
   • Use appropriate precautions at all times when handling blood or other body fluids.
   • Wrap blood tubes and viral transport medium (containing the swabs) separately in absorbent material, e.g. cotton wool.
   • Place the specimens in a secondary container, preferably sturdy plastic or stainless steel with a well-fitting lid.
   • Wrap the above in absorbent material and place in another container.
   • Attached the patient details on the outside of this container including:
     • Patient name and hospital number;
     • Doctor and contact number;
     • Laboratory name and contact person; and
     • Clinical details and results of any tests already performed.
   • The above package must be address to the following address:
     Dr. Terry Besselaar: National Influenza Unit, National Institute for Communicable Diseases, 1 Modderfontein Road, Sandringham, Johannesburg, 2059.
14. Completion of the data collection form during an avian influenza investigation of humans (see Figure 21 below).

<table>
<thead>
<tr>
<th>FIGURE 21</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATA COLLECTION FORM: AVIAN INFLUENZA INVESTIGATION OF HUMANS</td>
</tr>
</tbody>
</table>

**Information of specimen collector**

- Name of specimen collector:
- Contact detail of specimen collector (address, telephone and e-mail):

**Date of specimen collection:** DD / MM / YY

**Locality (with coordinates)**

- Country:
- Municipality:
- Health district:
- Province:
- Locality (GPS reference):
- Place where specimens were collected:
- Place where specimens were taken to (name, address and telephone of laboratory):

**Information of patient**

- Name of patient:
- Contact detail of patient (address and telephone):

**Specimen information**

- Unique specimen identification number:
- Specimen type (specify):
- Date specimen sent to laboratory: DD / MM / YY
- Date results received: DD / MM / YY
- Laboratory results/comments:

**Diagnosis**

- Tentative diagnosis/comments:
- Final diagnosis (diagnosing officer and date of diagnosis) comments:
- Health of patient when specimen was collected: Apparently healthy, sick or dead:

**Actions and treatment**

- List of actions (quarantine, etc.):
- List of treatments (antiviral drugs, etc.)

Source: Own research findings and confirmed by the Provincial Communicable Disease Outbreak Control Co-ordinators (group of experts) on 31 August 2008.
In developing the work methods and procedures in this annexure the resources listed below were consulted. The work methods and procedures were confirmed by the Provincial Communicable Disease Outbreak Control Co-ordinators (group of experts) on 31 August 2008.

The equipment listed below should be included in the avian influenza investigation kit. These are:

- standard size, disposable boot covers;
- antifog spray;
- alcohol based hand wash;
- reusable clear screen goggles;
- face masks (N95/FFP2, cup and folded models);
- overalls with head cover (Cat III CE 0120 overalls that are resistant to penetration by liquid);
- bio-packaging (inner and outer unit) 1.5L with ice pack;
- tubes for viral transport media;
- sterile pernasal swabs (with plastic shafts);
- sterile dacron swabs (plastic shafts);
- reliable transport;
- latex or nitrile gloves;
- face shields;
- local maps or aerial pictures;
- a global positioning system (GPS) instrument;
- note pads, pencils, watches; and
- disposable particulate respirators with valves.

AVIAN INFLUENZA INFECTION CONTROL MEASURES

Standard infection control precautions:

- Transmission of human influenza is by droplets, fine droplet nuclei (airborne) and direct or indirect contact.
- Reinforce standard infection control precautions with droplet and contact precautions.
- Isolate the patient to a single room. If a single room is not available, cohort patients separately in designated multi-bed rooms or wards; beds should be placed more than 1 metre apart and preferably be separated by a physical barrier (e.g. curtain, partition).
- Wearing gloves during any contact with the patient is essential.
- Wash hands thoroughly and dry after each patient contact and particularly after removing gloves. (Alcohol-based hand disinfection alone is not sufficient)

If the diagnosis of influenza A (H5N1) infection is being considered on the basis of clinical features, additional precautions (including airborne precautions) should be implemented until that diagnosis can be ruled out.

Additional infection control precautions

Airborne precautions:

- During the 1997 H5N1 outbreak in humans in Hong Kong SARS, droplet and contact precautions successfully prevented nosocomial spread of the disease. So far there has also not been any evidence to suggest airborne transmission of the disease in the current outbreaks in Thailand, Vietnam and Turkey.
- Due to the high mortality of the disease and the possibility of a pandemic, the World Health Organisation is currently recommending airborne precautions in addition to droplet and contact precautions – this includes the use of high efficiency (N95)
masks and where available negative pressure isolation rooms.

- Appropriate personal protective equipment (PPE) - when entering patient’s room:
- High - efficiency (N95) mask, gown, face shield / goggles and gloves
- Limit patient contact.
- Limit the number of health care workers and other hospital employees (e.g. cleaners, laboratory personnel) who have direct contact with the patient(s).
- Health care workers should not look after other patients.
- Restrict the number of visitors and provide them with appropriate personal protective equipment.

**Use designated health care workers:**

- Ask health care workers with direct patient contact to monitor their own temperature twice daily and report any febrile event.
- Health care workers who are unwell should not be involved in direct patient care.

**Household contacts:**

- Ask household contacts to monitor their own temperature twice daily and report the findings to the local health authorities.
- Self - quarantine for a period of 1 week after the last exposure to an infected person is probably appropriate.

**Disposal of waste:**

- Place waste in sealed, impermeable bags (clearly labelled “Biohazard” and incinerate).
- Linen and reusable materials that have been in contact with patients should be handled separately and disinfected by washing in hot water.

**Immunisation:**

- Countries or territories experiencing outbreaks of HPAI in poultry should vaccinate health care workers and poultry workers at risk with the World Health Organization’s recommended seasonal vaccine. H5N1 vaccines for humans are currently not commercially available.
Hospital Infection control:

- As influenza is a well-known nosocomial pathogen, existing infection control measures include the application of standard infection control precautions (droplet and contact precautions) to all patients receiving care.

Source: Adapted from National Department of Health (2006), Western Cape Department of Health (2006) and confirmed by the Provincial Communicable Disease Outbreak Control Coordinators (group of experts) on 31 August 2008.
### Information of health care worker

<table>
<thead>
<tr>
<th>Where appropriate, mark your selection with a cross (x).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name:</td>
</tr>
<tr>
<td>Job title:</td>
</tr>
<tr>
<td>Home telephone number:</td>
</tr>
<tr>
<td>Name of health facility:</td>
</tr>
<tr>
<td>Address of health facility:</td>
</tr>
<tr>
<td>Telephone:</td>
</tr>
<tr>
<td>Fax:</td>
</tr>
<tr>
<td>Health District Province:</td>
</tr>
<tr>
<td>Date of exposure: DD / MM /YY</td>
</tr>
</tbody>
</table>

### Exposure history of health care worker

Type of contact with avian influenza patient, patient environment, or virus:

Was personal protective equipment (PPE) used: No _____ Yes ______
If yes, list PPE used (e.g., gown, gloves, particulate respirator, surgical mask, eye protection, etc):

List any non-occupational exposures (i.e., exposure to birds or persons with severe acute respiratory illness):

Please check your temperature twice a day for 10 days after providing care for an avian influenza-infected patient, including 10 days after your last exposure, and also monitor yourself for any of the following influenza-like illness (ILI) symptoms:

- Fever > 38° C;
- Cough;
• Acute onset of respiratory illness;
• Sore throat;
• Arthralgia;
• Myalgia or prostration; and
• gastrointestinal symptoms (e.g., diarrhea, vomiting, abdominal pain).

If any symptoms of influenza-like illness occur, immediately limit your interactions with others, public areas, and notify the local health authority immediately.

<table>
<thead>
<tr>
<th>Day</th>
<th>Date</th>
<th>Temperature in degrees celsius</th>
<th>List any influenza-like illness symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1</td>
<td>DD / MM / YY</td>
<td>Morning:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Evening:</td>
<td></td>
</tr>
<tr>
<td>Day 2</td>
<td>DD / MM / YY</td>
<td>Morning:</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Evening:</td>
<td></td>
</tr>
<tr>
<td>Day 3</td>
<td>DD / MM / YY</td>
<td>Morning:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Evening:</td>
<td></td>
</tr>
<tr>
<td>Day 4</td>
<td>DD / MM / YY</td>
<td>Morning:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Evening:</td>
<td></td>
</tr>
<tr>
<td>Day 5</td>
<td>DD / MM / YY</td>
<td>Morning:</td>
<td></td>
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<td></td>
<td></td>
<td>Evening:</td>
<td></td>
</tr>
<tr>
<td>Day 6</td>
<td>DD / MM / YY</td>
<td>Morning:</td>
<td></td>
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<td></td>
<td></td>
<td>Evening:</td>
<td></td>
</tr>
<tr>
<td>Day 7</td>
<td>DD / MM / YY</td>
<td>Morning:</td>
<td></td>
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<td></td>
<td></td>
<td>Evening:</td>
<td></td>
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<tr>
<td>Day 8</td>
<td>DD / MM / YY</td>
<td>Morning:</td>
<td></td>
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<td></td>
<td></td>
<td>Evening:</td>
<td></td>
</tr>
<tr>
<td>Day 9</td>
<td>DD / MM / YY</td>
<td>Morning:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Evening:</td>
<td></td>
</tr>
<tr>
<td>Day 10</td>
<td>DD / MM / YY</td>
<td>Morning:</td>
<td></td>
</tr>
</tbody>
</table>

Source: Own research findings and confirmed by the Provincial Communicable Disease Outbreak Control Co-ordinators (group of experts) on 31 August 2008.
1. **Sampling strategy for birds**
   - Specimens for isolation of H5N1 and other respiratory viruses and for the direct detection of viral antigen or nucleic acids from animals should generally be taken during the first three days after onset of clinical symptoms of influenza.
   - For each affected species, select up to three each of:
     - dead birds (dead less than 24 hours)
     - sick birds
     - apparently normal birds in direct contact with the currently sick birds.
   - Priority should be given to birds that share wetlands with affected birds since there is evidence that the main mode of transmission of avian influenza between wild birds is probably faecal contamination of the environment (water or shore areas).

2. **Required specimen for live birds**
   Sampling of live birds for influenza infection should include:
   - tracheal swab (the primary sample for domestic and intensively reared poultry)
   - cloacal swab
   - faecal specimen

3. **Preparing for sampling**
   - Before collecting samples, personnel should put on the appropriate personal protective equipment (see avian influenza sample kit in Annexure 21). These include latex or nitrile gloves and face shields, and if it is determined to be necessary, powered air-purifying respirators.
   - Label plastic whirl pack bags with the necessary information including date, location (GPS coordinate if possible), species (if possible), investigator and sample identification code. Record all required information on data sheets. See Section 9 of Annexure 24 (Data collection form for an avian influenza investigation).
4. Applying restrain during live bird specimen collection

- The key to obtaining good samples from animals is proper restraint.
- At least two operators are needed for each live bird sampled.
- Three and sometimes four operators are needed for larger birds (swans, large geese, storks, etc).
- To obtain the sample with minimal distress to the live bird, one assistant should hold the bird against their chest with the wings folded (helped by other assistants if required).
- Cloacal samples can also be taken with the bird restrained in this way.
- An apron that cannot easily be ripped by the bird’s claws should be used. Do not use the wings or neck to restrain the bird, nor hold the legs and do not hold the bird upside down while carrying it.

5. Procedures for the collection of tracheal / cloacal swab samples

- Firstly prepare the sample vials.
- Samples must be placed in tubes containing viral transport medium or brain-heart infusion broth.
- Thaw appropriate number of pre-labelled tubes of viral transport medium or brain-heart infusion broth at refrigerator temperature (4 °C) overnight. Keep chilled with wet/blue ice packs in a cooler during the day of collection.
- When tracheal / cloacal swab samples are taken unwrap a dacron swab from the stem-end of the packaging.
- Remove the swab and insert the entire head of the swab into the trachea or cloaca.
- Use gentle pressure and in a circular motion, swab the inside circumference of the trachea/cloaca two or three times.
- For cloacal swabs, shake off large pieces of feces.
- Inserting the swab into the tube containing viral transport medium or brain-heart infusion broth.
- With the swab in the media, swirl the stem end of the swab between fingers vigorously. Lift the swab approximately half a centimeter from the bottom of the vial and bend the stem over the edge of the vial to break off the stem so that the swab remains in the vial and the cap can be screwed tight.
- The entire swab end and a portion of the stem will be left in the tube.
• If the stems are unable to be broken (some small swabs will have metal stems) then they can be cut with scissors. Scissors should be wiped with 70% alcohol each time they are used to cut a stem.
• Record the sample tube number on the banding sheet or the Sample History Sheet along with the date, species, age, sex, and location data (GPS coordinates if possible).
• Replace the tube into the cooler for transport back to the base camp.
• Samples should be kept cold (<4 °C, frozen if possible) and out of direct sunlight.
• At the sampling site, transfer the tubes into liquid nitrogen shippers or into a freezer as soon as possible.
• Place the tubes into a hard plastic transport container with enough frozen gel (dry ice) packs to keep samples cold for at least two days.
• Notify the laboratory that the samples are being shipped.

6. Taking of blood samples from birds.
   • Live birds should first be euthanised.
   • Birds suspected of suffering from HPAI should be killed by cervical dislocation (neck wringing) only. Other methods present safety risks.
   • Immediately after the bird is dead, perform a cardiac bleed to collect blood for serum separation.
   • Select the size of needle used in proportion to the size of the bird.
   • For duck-sized birds, aim a three centimetre long needle just below the keel (breast bone),
   • withdraw the blood with minimal negative pressure
   • When a sufficient volume (1ml) of blood is obtained, put pressure on the plunger and withdraw the needle from the chest cavity.
   • Without removing the needle, slowly expel the blood into a labelled vacutube and dispose of the needle and syringe in the sharps container without replacing the plastic needle cover.

7. Sampling dead birds and other animals
   • If dead birds/mammals are found during the investigation, and highly pathogenic avian influenza virus is suspected, representative internal organs should be sampled as well as the respiratory and intestinal tracts.
• The specimens to be collected from dead animals should include the tracheal swab, cloacal swab, tissue (including trachea and lung). The specimen should also include a piece of spleen and any obviously abnormal tissue.

• Tracheal swabs from dead animals, including animals at slaughter houses, can be taken after removal of the lungs and trachea from the carcasses. The trachea is held in a gloved hand and the swab inserted to its maximal length with vigorous swabbing of the wall. The swab is then placed in viral transport medium.

• Tissue specimens should ideally be frozen immediately, without transport medium, and transported frozen (-70 °C or below).

• Alternatively such specimens can be preserved in 100% ethanol or in a commercially available non-toxic RNA preservative if no cold chain is available.

8. Taking faecal samples during the surveillance of avian influenza

• Faecal specimens from the cages of live poultry in bird markets, from poultry houses or from wild birds in the field should, if possible, be collected from freshly deposited wet faeces.

• The swab should be heavily coated with faeces and then placed in viral transport medium.

• It is important to note that faecal specimens collected from cages or from the environment are often the only specimens available, but they cannot be assigned with certainty to the species of origin.

• Faeces must be less than 24 hours old.

• Faeces should appear moist.

• For collection, turn a sterile Whirl-Pak inside out and pick up faeces using the Whirl-Pak as a glove. Then turn the bag right side in with the faeces inside the closed bag.

• Release as much air from the inside of the bag as possible.

• Label the Whirl-Pak using an indelible ink marker. The sample should be labelled with the sample number, date, time, collector's name, location, and quality assurance number (Protocol Number).

• Place the Whirl-Paks with faecal samples into a large zip-lock bag, tape (e.g. duct tape or packaging tape) the opening and label the outer bulk bag with name, date, location, and protocol number.
• Pack samples with enough ice or frozen gel packs to keep samples cold for at least two days.
• This precaution is for maximizing the chances for subsequent viral isolation.
• Maintain the temperature of samples as constant as possible.
• Change gloves if it is soiled or contaminated.
• When finished collecting the sample, wash the hands with a suitable antibacterial agent.
• Notify the laboratory that the samples are being shipped.

9. Completion of the data collection form during an avian influenza investigation of birds
• The data form as below should be completed during the investigation of avian influenza amongst birds.

| FIGURE 22 |
| DATA COLLECTION FORM: AVIAN INFLUENZA INVESTIGATION OF BIRDS |

**General information**

| Name of reporting institution: |
| Name of health official: |
| Type of observation: Initial / Follow-up: |
| Date of observation: DD / MM / YY |
| Date of first case: DD / MM / YY | Date of end of outbreak: DD / MM / YY |
| Source of information: | Sensitivity (High/Low): |

**Public / private comments:**

**Locality (with coordinates)**

<p>| Country: | Municipality: |
| Health district: | Province: |
| Locality (GPS reference): | Name of farm: |
| Farming System: |</p>
<table>
<thead>
<tr>
<th>Birds affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Specify eg. chickens, ducks, etc.)</td>
</tr>
<tr>
<td>If uncertain of name, take a digital photograph</td>
</tr>
<tr>
<td>Species/signs :</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species:</td>
</tr>
<tr>
<td>Sample identification code:</td>
</tr>
<tr>
<td>Date sample sent to laboratory:</td>
</tr>
<tr>
<td>DD / MM / YY</td>
</tr>
<tr>
<td>Laboratory results/comments:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tentative diagnosis (differential diagnosis) comments:</td>
</tr>
<tr>
<td>Final diagnosis (diagnosing officer and date of diagnosis) comments:</td>
</tr>
<tr>
<td>Health of bird: Apparently healthy, sick or dead:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Actions and treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>List of actions (eg. destruction, vaccination, quarantine, stamping-out, etc ):</td>
</tr>
</tbody>
</table>

Own research findings and confirmed by the group of experts on 31 August 2008.

*In developing the work methods and - procedures in this annexure the resources listed below were consulted. The work methods and - procedures were confirmed by the Provincial Communicable Disease Outbreak Control Co-ordinators (group of experts) on 31 August 2008.


ANNEXURE 25

WORK METHODS AND PROCEDURES FOR SPECIMEN COLLECTION DURING SEROLOGICAL SURVEILLANCE OF POULTRY

1. Sample strategy

All serological testing has to be designed to detect the presence of the exposure of ostriches/chickens to H5 and H7 avian influenza subtypes (NAI) at >10% prevalence with 95% confidence in every epidemiological unit on each farm or site, i.e. the number of poultry to be tested depends on the size of each group on every farm. Table Four below, reflects the sample strategy for poultry.

<table>
<thead>
<tr>
<th>Size of the epidemiological group (population)</th>
<th>Number of poultry to be sampled (Chickens, ostriches, ducks etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 10</td>
<td>10</td>
</tr>
<tr>
<td>≤ 20</td>
<td>16</td>
</tr>
<tr>
<td>≤ 50</td>
<td>22</td>
</tr>
<tr>
<td>≤ 100</td>
<td>25</td>
</tr>
<tr>
<td>≤ 200</td>
<td>27</td>
</tr>
<tr>
<td>≤ 900</td>
<td>28</td>
</tr>
<tr>
<td>&gt; 900</td>
<td>29</td>
</tr>
</tbody>
</table>

2. Selection of the sample site

- As many randomly selected epidemiological units as possible should be tested bi-annually (6 monthly) with a minimum of 50 flocks/units per province.
- Properties to be selected must be on a random geographical basis. This includes the identification of a site (point) in a random fashion, with sampling carried out on the property with chickens that are closest to the identified site (be it a rural site or a commercial poultry farm).
- Samples must be submitted for H5 and H7 testing to one of the official laboratories as detailed in section six below.
Applying restraint during live poultry specimen collection

- The key to obtaining good samples from animals is proper restraint.
- At least two operators are needed for each live chicken sampled.
- Three and sometimes four operators are needed for larger birds (swans, large geese, storks, etc.).
- To obtain the sample with minimal distress to the live bird, one assistant should hold the bird against his/her chest with the wings folded (helped by other assistants if required).
- An apron that cannot easily be ripped by the bird’s claws should be used. Do not use the wings or neck to restrain the bird nor hold the legs and do not hold the bird upside down while carrying it.

3. Taking of blood samples

- Blood samples must be taken in red-topped tubes (tubes without any anti-coagulant).
- If possible, draw serum off after the blood has clotted.
- Poultry suspected of suffering from HPAI should be killed by cervical dislocation (neck wringing) only. Other methods present safety risks.
- Immediately after the bird is dead, perform a cardiac bleed to collect blood for serum separation.
- Select the size of needle used in proportion to the size of the bird.
- For duck-sized birds, aim the needle just below the keel (breast bone).
- Withdraw blood with minimal negative pressure.
- When a sufficient volume (1ml) of blood is obtained, release the negative pressure on the plunger and withdraw the needle from the chest cavity.
- Without removing the needle, slowly expel the blood into a labelled red-topped tube and dispose of the needle and syringe in the sharps container without replacing the plastic needle cover.

4. Shipping specimens

- Requirements determined by national authorities and commercial carriers must be complied with.
- The address label on a package should display the sender as well as the laboratory name with complete addresses and telephone numbers of both the sender and the receiver.
• A package should also contain the appropriate biohazard labels and as well as the storage temperature requirements.
• Copies of letters, forms, permits and other identifying/shipping documents for the receiving laboratory should be placed together in a plastic bag and taped onto the outer transport packaging.
• The receiving laboratory should receive a copy of these documents in advance.

5. **Submission of serum samples**
• Submit serum samples only to one of the following official laboratories:
  • For the Eastern Cape province: Onderstepoort Veterinary Institute, Virology Section, Onderstepoort, 0110 (Tel: 012 – 529 9111).
  • Allerton Veterinary Laboratory, 458 Townbush Road, Montrose, Pietermaritzburg, 3201 (Tel: 033 – 347 6204)
  • Stellenbosch Veterinary Laboratory, Helshoogte Road, Stellenbosch, 7600 (Tel: 021 – 887 0324).

6. **Investigation form to be completed.**
   See Section 9 of Annexure 24.

7. **Submission of serological reports**
• A serological report must be submitted to the Provincial Health Department every six months. Full records of sampling dates, sites, laboratory result sheets, etc, must by kept in the Health District for auditing purposes.
• The report should include the following information: name of farm or establishment, owner of farm (name and initials), magisterial district, geographical reference points, date of sampling results and laboratory where tested.

*In developing the work methods and - procedures in this annexure the resources listed below were consulted. The work methods and - procedures were confirmed by the Provincial Communicable Disease Outbreak Control Co-ordinators (group of experts) on 31 August 2008.


Schematic representation of laboratory tests for determining evidence of avian influenza infection of poultry flocks using virological methods.
Schematic representation of laboratory tests for determining evidence of avian influenza infection of poultry flocks using serological surveys.

Key:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGID</td>
<td>Agar gel immunodiffusion</td>
</tr>
<tr>
<td>DIVA</td>
<td>Differentiating infection from vaccinated animals</td>
</tr>
<tr>
<td>ELISA</td>
<td>Enzyme-linked immunosorbant assay</td>
</tr>
<tr>
<td>HA</td>
<td>Haemagglutinin</td>
</tr>
<tr>
<td>HI</td>
<td>Haemagglutination inhibition</td>
</tr>
<tr>
<td>NA</td>
<td>Neuraminidase</td>
</tr>
<tr>
<td>NP/M</td>
<td>Nucleoprotein and matrix protein</td>
</tr>
<tr>
<td>NSP</td>
<td>Nonstructural protein</td>
</tr>
<tr>
<td>S</td>
<td>No evidence of NAIV</td>
</tr>
</tbody>
</table>

Source: Adapted from Pienaar and Horner (2005, p.52) and confirmed by the group of experts on 31 August 2008.
ANNEXURE 27

WORK METHODS AND PROTOCOLS FOR HEALTH CARE WORKERS PROVIDING CARE TO AVIAN INFLUENZA INFECTED PATIENTS AT HEALTH CARE FACILITIES

1. **Work procedures at the arrival of suspected or confirmed avian influenza-infected patients at a health care facility**
   - Health care workers must start immediately with droplet precaution measures when a patient with symptoms of acute respiratory illness enters the facility.
   - Health care employees should use facial protection (surgical/procedure mask, goggles / face shield).
   - Place a surgical/procedure mask on the patient when in the waiting room. If no masks are available, ask the patient to cover his/her mouth and nose with a tissue (to be provided) when sneezing or coughing.

2. **Patient placement for suspected or confirmed avian influenza-infected patients in an isolation room**
   - Place the patient in a negative pressure room (airborne infection isolation room).
   - If a negative pressure room is not available or cannot be created with mechanical manipulation, place the patient in a single room.
   - Place patients that are avian influenza-infected and those that are suspected of being avian influenza-infected together in the same room if single rooms are not available.
   - If possible, try not to place patients with seasonal influenza and those with avian influenza in the same room. Although the risk is relatively small, the sharing of the same room by such patients would increase the chances of co-infection of patients with the two viruses and this could lead to viral reassortment of genes and the possible emergence of a new pandemic virus.
   - Doors to any room or area, housing suspected or confirmed avian influenza-infected patients must be kept closed when not being used for entry or exit.
   - To facilitate cleaning and to reduce the potential for virus aerosolisation via vacuuming, place avian influenza-infected patients in uncarpeted rooms/areas, if possible.
   - When possible, isolation rooms should have their own hand-washing sink, toilet and bath facilities.
The number of persons entering the isolation room should be limited to the minimum number necessary for patient care and support.

Ensure infection control precautions through appropriate signage on the door.

3. Cohorting of avian influenza-infected patients

- If single rooms are not available, patients infected with the same organisms can be cohorted (share rooms). These rooms should be in a well-defined area that is clearly segregated from other patient care areas used for uninfected patients.
- The distance between beds should be more than one metre. Increasing spatial distance between patients may theoretically be helpful in preventing transmission of respiratory aerosols.
- Whenever possible, health care workers assigned to avian influenza-infected patient care units should be experienced house staff and should not “float” or otherwise be assigned to other patient care areas.
- The number of persons entering the ward should be limited to the minimum number necessary for patient care and support.
- Consider having portable x-ray equipment available.
- Healthcare workers assigned to avian influenza-infected patient care units should be aware that avian influenza-infected patients may be concurrently infected or colonised with other pathogenic organisms (e.g., Staphylococcus aureus, Clostridium difficile) and should use standard and applicable transmission-based infection control precautions to prevent transmission of health care associated infections.

4. Placement and removal procedures of personal protective equipment when dealing with suspected or confirmed avian influenza-infected patients

In addition to hand hygiene, all individuals providing care for patients with respiratory illness or suspected or confirmed avian influenza infection should use personal protective equipment as described below:

- If possible, have an observer present outside the isolation room to monitor the placement and removal of personal protective equipment.
- Before entering the isolation room, collect all personal protective equipment needed.
The following equipment should be kept on a trolley (outside the isolation room) at all times so that personal protective equipment is always available for health care workers:

- Face shield/visor/goggles;
- Single use gloves for clinical use (sizes: small, medium, and large);
- Gloves (reusable for environmental cleaning);
- Hair covers (optional for high-risk procedures, but should be available);
- Particulate respirators (N95, FFP2, or equivalent);
- Surgical or procedure masks;
- Single-use long sleeved fluid-resistant gowns;
- Single-use plastic aprons (compulsory if splashing is anticipated);
- Alcohol-based hand rub or alternative method for washing hands in clean water;
- Plain soap (liquid if possible);
- Disinfectant;
- Clean single-use towels;
- Appropriate disinfectant for environmental cleaning;
- Large plastic bags;
- Appropriate clinical waste bags;
- Linen bags; and
- Collection container for used equipment.

- Perform hand hygiene with an alcohol-based hand rub (preferably) or soap and water.
- Put on personal protective equipment as in Figure 23.
Figure 23:

Placement of personal protective equipment, including surgical mask and goggles

Source: Adapted from the World Health Organization (2007c).

- Put on personal protective equipment as described in the sequences below:
- Put on fluid-resistant gown;
- Put on disposable particulate respirator;
- Perform user seal check of particulate respirator;
- Put on hair cover (if used, e.g. during an aerosol generating procedure);
- Put on face shield or goggles;
- Put on gloves (make sure gloves cover cuff of gown sleeves); and
- Enter the isolation room and close the door.
5. Procedures on leaving the isolation room

- Remove personal protective equipment in a manner that prevents self-contamination or self-inoculation with contaminated personal protective equipment or hands. If possible, have an observer monitor to the removal of personal protective equipment by health care workers in order to minimize further risks.

- When leaving the isolation room, remove personal protective equipment either in the anteroom or if there is no anteroom make sure that neither the environment outside the isolation room, nor other persons can get contaminated.

- Remove protective eyewear and discard in a rubbish bin. If reusable, place face shield in container for decontamination.

- If worn, remove hair cover and discard in a rubbish bin.

- Remove gown and discard in a rubbish bin.

- Remove gloves and discard in a rubbish bin (gloves may be peeled from hands when gown is removed).

- Perform hand hygiene with an alcohol-based hand rub (preferably) or soap and water.

- Remove particulate respirator by grasping elastic bands; do not touch the front of the particulate respirator (front of particulate respirator may be contaminated) and discard in a rubbish bin.

- Perform hand hygiene with an alcohol-based hand rub (preferably) or soap and water.

6. Disposal of suspected avian influenza waste

- All waste generated in the isolation room should be removed from the isolation room in suitable containers or bags that do not allow for spillage or leakage of the contents.

- Waste from avian influenza-infected patients is classified as infectious. All waste from an isolation room should be treated as clinical waste and should be treated and disposed of as per facility policy and in accordance with national regulations pertaining to such waste.

- One waste disposal bag is usually adequate, providing waste can be placed in the bag without contaminating the outside of the bag. If the outside of the bag is contaminated, two bags should be used (double bagging). If additional bags are not available, clean and disinfect the outside of the bag before removing it from the isolation room.

- When transporting waste outside the isolation room, use gloves followed by hand hygiene.

- Although the possibility of transmission of avian influenza infection via human faeces is unknown, faeces of avian influenza-infected patients should be handled with caution.
Possible aerosolisation of faeces should be avoided (e.g. removal of faeces from bedpan, commode, clothing, or reusable incontinence pads by spraying with water).

- Liquid waste, such as urine or faeces, can be flushed into the sewer system if there is an adequate sewage system in place. Close toilet cover after flushing.

7. **Environmental cleaning and disinfection of rooms and surfaces**

Environmental cleaning and disinfection is intended to remove pathogens from contaminated surfaces and items, thus breaking the chain of transmission. Disinfection is a process of killing microorganisms without complete sterilization. Cleaning must precede disinfection. Items and surfaces cannot be disinfected if they are not first cleaned of any kind of organic matter (patient excretions, secretions, dirt, soil, etc.). The environmental cleaning and disinfection methods that are in general considered effective in the inactivation of influenza A viruses are presented below:

The avian influenza virus can be inactivated by a range of disinfectants, including:

- phenolic disinfectants;
- quaternary ammonium compounds;
- peroxygen compounds;
- sodium hypochlorite (household bleach);
- ethanol;
- other germicides with a tuberculocidal claim on the label;
- other registered/licensed disinfectants;
- any germicide with a tuberculocidal claim on the label (i.e., an intermediate-level);
- Most disinfectants are considered capable of inactivating influenza;
- Use manufacturer’s recommendations for use/dilution, contact time, and handling of disinfectants;
- Patient rooms/areas should be cleaned at least daily and terminally cleaned at discharge;
- In addition to daily cleaning of floors and other horizontal surfaces, special attention should be given to cleaning and disinfecting frequently touched surfaces (e.g., medical equipment, bedside and over-bed tables, TV controls, call buttons, safety/pull-up bars, doorknobs, commodes and ventilator surfaces).
• To avoid possible re-aerosolisation of the avian influenza virus, damp, rather than dry dusting or sweeping should be performed, whenever possible. Wet-dust horizontal surfaces by moistening a cloth with a small amount of disinfectant.

• During wet cleaning, cleaning solutions and equipment quickly become contaminated; therefore clean less heavily contaminated areas first and change cleaning solutions, cleaning cloths, and mop heads frequently.

• Double bucket method (i.e., one bucket for cleaning solution, one for rinsing) is recommended.

• Equipment used for cleaning and disinfection must be cleaned and dried between uses.

• Mop heads should be laundered daily and dried thoroughly before storage or re-use.

• Carpeted areas should not be designated for avian influenza-infected patients.

• Keep areas around the patient free of unnecessary supplies and equipment to facilitate daily cleaning.

• Paper sheeting that is changed between patients is appropriate for patient examination tables in outpatient areas;

• Use disinfectant to wipe down tables between patients;

• Do not spray (i.e., fog) occupied or unoccupied rooms with disinfectant. This is a potentially dangerous practice that has no proven disease control benefit.

• It is furthermore important to note the following:
  • Chemical inactivation is only effective after physical removal of bulk contamination;
  • The hazards associated with chemical decontaminants can be avoided if instructions for their use are followed closely and appropriate personal protective equipment is worn.
  • Apart from the methods listed above, there are many other methods that can effectively kill these viruses. One should use the safest method possible when disinfecting areas known or suspected to be contaminated with the virus.

*In developing the work methods and - procedures in this annexure the resources listed below were consulted. The work methods and - procedures were confirmed by the Provincial Communicable Disease Outbreak Control Co-ordinators (group of experts) on 31 August 2008.


1. **Key public messages and advice to prevent the spread of avian influenza in affected areas**

- People should avoid contact with chickens, ducks or other poultry unless absolutely necessary. This is the best way to prevent infection with the avian influenza virus.
- Children are at high risk because they may play where poultry are found. It is therefore important to teach children the following basic guidelines:
  - Avoid contact with any birds, their feathers, faeces and other waste;
  - Do not keep birds as pets;
  - Wash hands with soap and water after any contact with birds; and
  - Do not to sleep near poultry.
- Do not transport live or dead chickens, ducks or other poultry from one place to another even if you think your birds are healthy.
- Handling of poultry in affected areas should be done within the area without transporting them to other areas.
- Do not prepare poultry from affected areas as food for your family or animals. The slaughter and preparation of such birds for food is dangerous.
- If you unintentionally come into contact with poultry in an affected area, such as touching the bird's body, touching its faeces or other animal dirt, or walking on soil contaminated with poultry faeces:
  - Wash your hands well with soap and water after each contact;
  - Remove your shoes outside the house and clean them of all dirt; and
  - Check your temperature for 7 days at least once daily. If you develop a high temperature (>37.5°C), visit a doctor or the nearest healthcare facility immediately.

2. **Proper handling of poultry**

- Make sure to keep children away from dead or sick poultry.
• If you need to handle dead or sick poultry, make sure you are protected. Wear protective clothing such as a mask, goggles, gown, rubber boots and gloves. If these are not available, cover your mouth with a piece of cloth, wear glasses, use plastic bags to cover hands and shoes and fix these tightly around wrists and ankles with a rubber band or string. Wear overalls that can be washed.

• If you encounter sick and/or dead poultry for the first time and are unsure of the situation, inform the health authorities immediately and leave the handling of the poultry to experienced personnel.

3. Decontamination of premises
Decontamination of an infected bird premises will help control the spread of the disease.

• If possible, ask experienced health personnel to help you decontaminate the premises. If this is not possible and you have to do it yourself, wear protective gear to protect your eyes, hands, feet and other exposed parts of your body as described above.

• Dead birds should be buried safely (see next section).

• Effective cleaning results in no visible feathers or faeces remaining on the premises.

• Influenza viruses can survive for some time in organic material, so thorough cleaning with detergents is an important step during decontamination.

• As outdoor areas used by poultry can be difficult to clean or disinfect, poultry should be excluded from these areas for a minimum of 42 days of decontamination to allow natural ultraviolet radiation to destroy any residual viruses. The period of exclusion should be longer in cold weather.

• Spraying of disinfectants on vegetated outdoor areas or soil is of limited value due to the inactivation of these chemicals by organic material. Removal of surface soil is not normally recommended unless it is heavily contaminated with faeces.

4. Buring of dead birds and their faeces
• As far as is possible, seek assistance from your local environmental health or agriculture authority on how to bury dead animals safely;

• When burying dead birds or their faeces, try to avoid generating dust. Spraying or sprinkle water to dampen the area first. Bury bird carcass and faeces at a depth of at least 1 metre.
• When the dead birds and their faeces have been properly disposed, clean all areas very well with detergent and water. Influenza viruses are relatively susceptible to a variety of detergents and disinfectants.

5. Handling/disposal of contaminated protective clothing

• After the area has been cleaned, remove all the protective materials and wash your hands with soap and water.
• Wash clothes in hot or warm soapy water. Hang them in the sun to dry.
• Put used gloves and any other disposable materials in a plastic bag for safe disposal.
• Clean all reusable items such as rubber boots and glasses/goggles with water and detergent, but always remember to wash your hands after handling these items.
• Items that cannot be cleaned properly should be destroyed;
• Shower/wash body using soap and water. Wash your hair and take care not to re-contaminate yourself or the cleaned area by avoiding contact with dirty, contaminated clothes and items.
• Wash your hands every time after handling any contaminated items.
• Footwear should also be decontaminated.
• After walking around areas that may be contaminated (such as farms, markets or backyards with poultry), clean your shoes as carefully as possible with soap and water.
• When cleaning shoes, make sure that you do not flick any particles into your face or on your clothes. Wear a plastic bag over your hands, shield your eyes by wearing glasses or goggles, and cover your mouth and nose with a cloth.
• Leave dirty boots and shoes outside the home until they have been thoroughly cleaned.

6. Additional precautions for people with flu-like symptoms

• The World Health Organization believes it is very important to prevent human influenza from spreading in areas affected by bird flu. Where the avian influenza viruses and human influenza viruses come in contact with each other, there is a risk that genetic material will be exchanged and a new virus could emerge.
• Anyone with flu-like illnesses should therefore be careful with secretions from the nose and mouth when around other people, especially small children, in order not to spread the human influenza viruses.
• Cover your nose and mouth when coughing or sneezing. Teach children to do this as well.
• Always wash your hands with soap and water after any contact with secretions from the nose or mouth as these can carry a virus.
• Children are especially prone to touching their face, eyes and mouth with unwashed hands. Teach children the importance of hand washing after coughing, sneezing and touching dirty items.
• Inform the health authorities immediately and seek medical advice from a health professional if you develop signs of illness, such as fever and/or flu-like symptoms.

7. **Precautions to be taken when visiting friends or relatives in health-care facilities**
• When visiting a patient who has bird flu, visitors must follow the advice from the hospital staff to wear protective clothing, including a mask, gown, gloves and goggles.
• Such special protective clothing is required when visitors have direct contact with the patient and/or the patient's environment.
• It is important that the protective mask should fit properly. If it doesn't, seek advice from the hospital staff.
• When visitors leave the patient's room they must remove these items and wash their hands with soap and water.

8. **Precautions need to be taken in neighbouring areas (next to the bird-flu affected area)**
• Only apparently healthy poultry should be prepared for food.
• For killing, use a method that does not contaminate you or the environment of your household with blood, dust, faeces and other animal dirt. Seek advice from the local environmental health authority about the proper procedure.
• For plucking, use a method that does not contaminate people or households with dust, faeces and other animal dirt. It is best to put poultry in boiling water before plucking feathers.
• For degutting, use a method that does not contaminate people or households with blood, dust, faeces and other animal dirt.
• People should not touch other items or their face (e.g. rubbing your eyes) during the degutting procedure, unless they have washed their hands with soap and water.
9. Precautionary measures to ensure that poultry and poultry products are properly prepared and safe to eat

- In affected areas it is advisable not to use dead and sick chicken or other poultry for preparing food for humans and/or animal consumption. Even healthy-looking poultry of any kind from a bird-flu affected area should not be used for food.
- Chicken prepared hygienically and cooked thoroughly, i.e. no pink juices should be observed, can be considered safe to eat. If the bird has a transmittable disease, such as bird flu, the person preparing the food is at risk of becoming infected and the environment may become contaminated.
- Eggs, too, may carry pathogens, such as the bird-flu virus inside or on their shells. Care must be taken in handling raw eggs and shells. Wash shells in soapy water and wash hands afterwards. Eggs, cooked thoroughly (hard boiled, 5 minutes, 70°C) will not infect the consumer with bird flu.
- In general, all food should be thoroughly cooked to an internal temperature of 70°C or above.

*In developing the work methods and procedures in this annexure the resources listed below were consulted. The work methods and procedures were confirmed by the Provincial Communicable Disease Outbreak Control Co-ordinators (group of experts) on 31 August 2008.

The following minimum biosecurity measures are recommended for poultry establishments:

1. Fencing
   • The poultry house/s or production site/s should be fenced off, ideally with electric fencing.

2. Access control for visitors and vehicles (i.e. feed trucks etc.) should be provided:
   • A security gate, preferably an electric gate, should prevent unauthorized entry to the establishment.
   • The access road to the establishments should run as far away from the site/s or house/s as possible, with dedicated smaller access road/s to each site.
   • Visitors should not be allowed inside the poultry houses, unless they have not had access to the poultry for at least the last three days or have taken a shower (removal of all clothes and including the washing of hair.
   • Feed trucks should be cleaned/disinfected at the feed depot and leave directly from the depot to the establishments.
   • Multiple deliveries of feed should be avoided at all times.
   • Feed silos should be erected with access by the feed truck from outside the fence.

3. Workers
   • Workers should have dedicated, specific jobs/tasks;
   • Enforce the wearing of protective clothing for all workers (at least overalls and gumboots for poultry houses and hatcheries.
   • Workers should be prohibited from keeping their own poultry, either at dwellings on the establishments itself or at their houses away from the establishments; and
   • Workers should not be allowed to bring poultry meat for consumption onto the premises.
4. Foot baths

- Properly administered foot baths should be placed at the entrance to all poultry houses. Foot baths should contain disinfectant that is replaced at regular intervals (as soon as dirty) and no entry or exit by workers if by-passing the foot bath.

5. Wild birds

- There should be no contact between wild birds and poultry.
- Houses should be constructed in such a way that wild birds cannot gain entry.
- No surface water should be allowed in the vicinity of the chicken houses. This includes open dams, ponds and furrows.
- Spilt feed must be removed immediately.

6. Rodents

- An effective rodent control programme should be followed.
- Rats and mice should not have access to poultry feed or poultry houses.

7. Traceability

- All poultry farms/holdings must be identified and registered with the local health authority. It is essential that all poultry/ostrich farms/holdings in the country, irrespective of size and whether the poultry or ostriches are kept for the export of meat, must be registered with the local health authorities. The said registration is essential to facilitate good record-keeping.
- Full geographical details of the location of the farm have to be obtained. The data should also include up-to-date figures on the number and age groups or type of birds on the establishment.
- All ostriches above the age of 3-4 months have to be tagged, but definitely before any movement occurs.
- A tag that is located under the wing is not the most practical identification method, as it can be read only once the ostrich has been caught and restrained.
- A tag that is located on the neck is more practical and should be used.
8. Disinfection

- Drinking water should be disinfected with a suitable disinfectant to inactivate any possible influenza virus without harming the ostriches. Registered disinfectants that could be used include: Virukill, Virkon or standard water chlorination methods.
- The supply of water for ostriches should consist of structured water troughs in properly constructed and dedicated areas that supply water without attracting wild birds.

9. Irrigation canals

- In areas where camps are linked by means of irrigation canals, these canals have to be fenced off. This will prevent faecal material from ostriches from being transported to neighbouring camps along the route of the canal system.
- The supply of water for poultry should consist of structured water troughs in properly constructed and dedicated areas that supply water without attracting wild water birds.

Source: Modified from Pienaar & Horner (2005, p.58), Swane & Akey (2003, p.120) and confirmed by the Provincial Communicable Disease Outbreak Control Co-ordinators (group of experts) on 31 August 2008.
ANNEXURE 30

WORK METHODS AND PROCEDURES FOR THE ELIMINATION OF INFECTED POULTRY*

1. Staff and equipment necessary for depopulation and disposal of infected birds
   - Wooden poles to cordon of the infected premises.
   - Red-and white-tape to identify the infected premises and the entrance/exit to the farm.
   - Mobile disinfection units.
   - Night-time illumination devices.
   - Sufficient staff (depopulation crews and other staff) to avoid overworking.
   - Local maps for the identification of the route for the vehicles carrying the dead birds.
   - Policemen or other social security service to escort the trucks to the disposal area.
   - Gas, drugs or devices to contain, sedate, stun and depopulate flocks (in case of ostriches a captive bullet revolver may be used); and
   - Appropriate containers for disposing infected material.

2. Disinfectants which are effective against avian influenza virus
   A list of disinfectants which are active against the avian influenza virus, their concentration and recommended use is presented below:
   - Sodium hypochlorite: 2% active chlorine solution (disinfection of equipment).
   - Quaternary ammonium salts: 4% solution (treatment of walls, floors, ceilings and equipment).
   - Potassium peroxomonosulphate + sulphamic acid + sodium alkyl benzene sulphonate as a ready-to-use product (treatment of floors, walls, ceilings and equipment).
   - Calcium Hydroxide: 3% solution (treatment of walls and floors).
   - Cresolic acid 2.2% solution: (treatment of floors).
   - Synthetic phenols 2% solution: (treatment of floors).
   - Formalin and permanganate: fumigation.

2. Euthanasia of poultry
   During euthanasia, controlled atmospheric killing is performed by exposing animals to a predetermined gas mixture, either by placing them in a gas-filled container or apparatus
(Method 1) or by the gas being introduced into a poultry house (Method 2). Method 2 should be used whenever possible, as it eliminates welfare issues resulting from the need to manually remove live birds. The usage of carbon-dioxide gas is the preferred method for euthanasia. Inhalation of carbon dioxide (CO₂) induces respiratory and metabolic acidosis and hence reduces the pH of cerebrospinal fluid (CSF) and neurons thereby causing unconsciousness and, after prolonged exposure, death.

**Method 1**
- The animals are placed in a gas-filled container or apparatus.
- With caged layers, individual birds must be removed from cages and manually placed in large airtight containers and CO₂ added.
- The containers or apparatus should allow the required gas concentration to be maintained and accurately measured.
- When animals are exposed to the gas individually or in small groups in a container or apparatus, the equipment used should be designed, constructed, and maintained in such a way as to avoid injury to the animals and allow them to be observed.
- Gassing: CO₂ (use 17.5 kg/1000 m³). Birds need to be exposed to an atmosphere of at least 30% carbon dioxide to ensure loss of consciousness and then at least 70% carbon dioxide to kill the birds. This concentration must be maintained for at least 3 minutes until death is confirmed.
- Team members should ensure that there is sufficient time allowed for each batch of animals to die before subsequent ones are introduced into the container or apparatus.
- Containers or apparatus should not be overcrowded and measures are needed to avoid animals from climbing on top of each other.

The advantages of Method 1 are that CO₂ is readily available and the application methods are simple. The disadvantages include the following:
- The gas container or apparatus should be properly designed;
- The aversive nature of high CO₂ concentrations;
- No immediate loss of consciousness;
- The risk of suffocation due to overcrowding; and
- Difficulty in verifying death while the animals are in the container or apparatus.
From the above it can be concluded that Method 1 is suitable where small numbers of birds need to be euthanised. The portable, self-contained euthanasia chambers can be constructed and moved to the site for use.

**Method 2**

- During this method the gas is introduced into a poultry house.
- Prior to introduction of the CO₂, the poultry house should be appropriately sealed to allow control over the gas concentration.
- Small house: Seal house or remove birds into containers for gassing or dislocation of necks.
- The house should be gradually filled with CO₂ so that all birds are exposed to a concentration of more than 40% until they are dead; a vaporiser may be required to prevent freezing.
- Devices should be used to accurately measure the gas concentration at the maximum height accommodation of birds.

The advantages of Method 2 are that by applying gas to birds in situ eliminates the need to manually remove live birds, CO₂ is readily available and the gradual raising of CO₂ concentration minimises the unpleasantness of dealing with unconscious birds. The disadvantage is that it is difficult to determine the volume of gas required to achieve adequate concentrations of CO₂ in some poultry houses. It is also difficult to verify death while the birds are in the poultry house.

From the above it can be concluded that Method 2 is suitable for use with the poultry in an enclosed-environment. It is also suitable for broilers, layers and breeders. The section below discusses drugs that may be used for depopulation of large flocks of birds.

**3. Drugs that may be used for depopulation of large flocks of birds**

- Alfa chloralose, mixed with feed in concentration of 2%-6%, causes loss of consciousness. Death can also be obtained by suffocating birds in plastic bags. This method can be used only if the birds are clinically ill and do not exhibit any loss of appetite.
- Sodium fenobarbital, dissolved in drinking water (80 mg in 55 mls), causes loss of consciousness in four hours.
4. Disposal of dead birds

Disposal of dead birds can be done through various methods including:

- On-farm burial;
- Incineration;
- Composting; and
- Landfill disposal.

The following section discusses on-farm burial of dead birds:

- On-farm burial of dead birds is preferred to the other methods listed above. In areas which allow burial as a means of disposal, a pit must be prepared as soon as the diagnosis is confirmed. The size of the pit must be at least two metres wide by two metres deep, and this enables disposal of 300 birds (medium weight 1.8 kg) per 1.3 meters of surface. The number of birds can be doubled, each metre deeper the pit is made (3-6 metres). The bottom of the trench must be at least 1 metre above the water table to prevent contamination of the ground water.
- Non-disinfectable biodegradable material must be buried with the birds.
- Cover the birds with a layer of calcium hydroxide (quicklime).
- The excavated area must be protected against theft (e.g. razor wire).
- All non-disinfectable, biodegradable material (wood, cardboard) must be buried with the animals.

5. Disposal / destruction of infected materials

All organic waste and all other non-disinfectable material must be destroyed. In particular, the destruction of litter, eggs, egg products, hay, animal feedstuffs, feathers and egg-trays must be planned for.

- Litter - Depending on the amounts of litter present and on the characteristics of it, litter can be either buried in the pit with the animal carcases or piled in heaps to ensure maturation. The heap must be covered with a water resistant sheet of plastic. In all cases, infected litter should not be moved from the infected farm prior to maturation.
- Eggs and egg products - May be buried in the pit with the bird carcases.
- Straw - Straw may be decontaminated by spraying its surface with an active disinfectant and covering up the stacks with a water resistant sheet of plastic. Covered stacks must be
left to decontaminate for at least 42 days. For time reasons, it could be more convenient to incinerate it.

- Animal feed - Animal feed present on the site must be decontaminated by fumigation and subsequently incinerated.

7. Disinfection of infected premises

- All units which are physically or functionally connected to the establishment (i.e. hatchery, egg storage rooms, packaging rooms, egg trolleys, egg product plants) must be properly disinfected. Vehicles, used for transporting live animals, eggs and animal feed must also be disinfected;
- Washing and disinfection of walls, floors and ceilings of the infected establishments must be performed aiming at the removal of all organic material; metal structures such as cages may be decontaminated by heat treatment;
- All equipment inside the house such as drinkers and food hoppers must be washed and treated with a disinfectant;
- Water reservoirs must be emptied, washed and disinfected;
- Feed tanks (silos) need to be emptied, washed with a hot water-pressure pump and subsequently fumigated; and
- After washing and disinfecting, all units must be fumigated twice with at least two weeks between fumigations.

*In developing the work methods and - procedures in this annexure the resources listed below were consulted. The work methods and - procedures were confirmed by the Provincial Communicable Disease Outbreak Control Co-ordinators (group of experts) on 31 August 2008.

SECTORS THAT SHOULD SERVE ON THE NATIONAL AVIAN INFLUENZA OUTBREAK RESPONSE TEAM

The sectors below form the National Department of Health are the sectors that should serve on the National Avian Influenza Outbreak Response Team.

1. Directorate: Communicable Disease Control
2. Directorate: Epidemiology
3. Directorate: Health Promotion
4. Directorate: Environmental Health
5. Directorate: Food Control
6. Cluster: Communication
7. Directorate: Human Resources
8. Directorate: Health Information Systems
10. Directorate: Emergency Medical Services and Disaster Management
13. South African Military Health Services
14. Department of Finance
15. Department of Water Affairs and Forestry
16. Department of Provincial and Local Government
17. Department of Agriculture
18. Department of Social Development
19. Department of Safety and Security
20. Department of Education
21. Department of Foreign Affairs
22. Department of Correctional Services
23. Private Health Sector
24. International Organisations (World Health Organization, etc)
25. Southern African Development Community (SADC)
Source: National Department of Health (2007, p.16) and confirmed by Provincial Communicable Disease Outbreak Control Co-ordinators (group of experts) on 31 August 2008.
ANNEXURE 32

SECTORS THAT SHOULD SERVE ON THE PROVINCIAL AVIAN INFLUENZA OUTBREAK RESPONSE TEAM IN THE EASTERN CAPE PROVINCE

The sectors below from the Provincial Department of Health are the sectors that should serve on the Provincial Avian Influenza Outbreak Response Team of the Eastern Cape province.

1. Director: Primary Health Care Service
2. Deputy-Director: Environmental Health
3. Human Resources Unit
4. Health Promotion Unit
5. Communication Unit
6. Infection Control Unit
7. Legal Services
8. Emergency Medical and Rescue Services (EMRS)
9. Hospital Services
10. Food Control Unit
11. Pharmacies Unit
12. Surveillance Unit
13. Defence Force
14. Port Health
15. Provincial Call centre
16. Expanded Programme for Immunisation
17. Geographical Information System Unit
18. Epidemiology Unit
19. Informatics Unit
20. Community health worker programme manager
21. Representative from private health sector
22. South African Military Health Services (SAMHS)
23. Safety and Security Unit
24. Water Affairs and Forestry
25. Correctional Services
26. Foreign affairs
27. Agriculture and veterinary science
28. Disaster management
29. South African Police Services
30. Telkom
31. Business
32. NGOs

Source: Nagpal (2006, p.15) and confirmed by Provincial Communicable Disease Outbreak Control Co-ordinators (group of experts) on 31 August 2008.