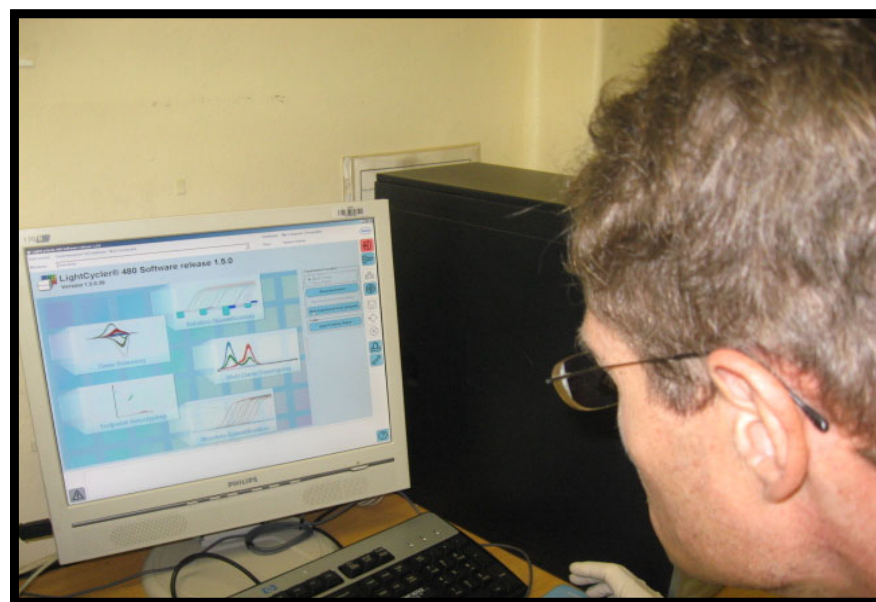
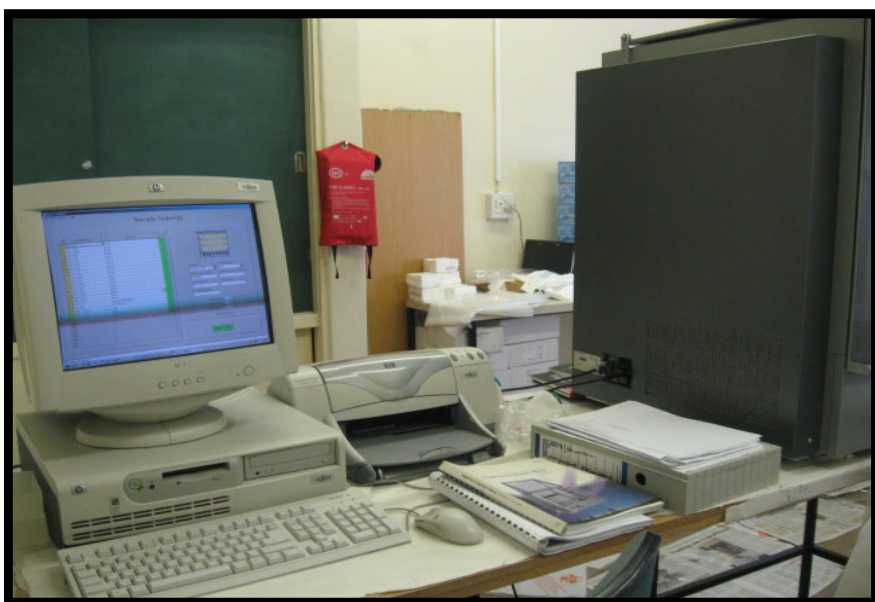


# Avian influenza in South Africa

**Marco Romito**  
**Diagnostic PCR Laboratory**  
**Agricultural Research Council**  
**Onderstepoort Veterinary Research**

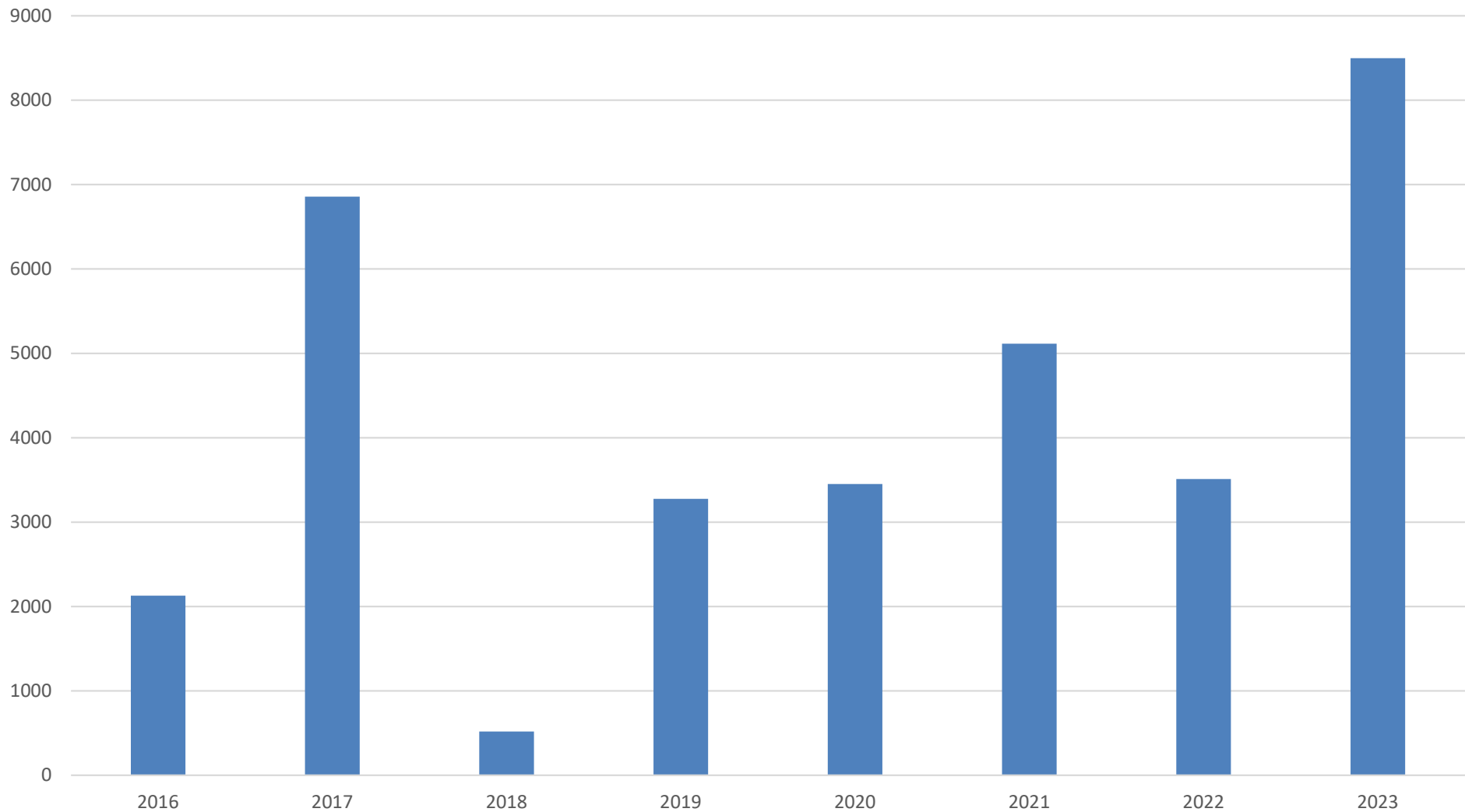




# AIV testing at ARC-OVR

- AIV PCR screenings done from 2004 onwards
- Initially NASBA & conventional RT-PCR:
  - influenza A, H5 & H7 subtypes.
- **Real-time RT-PCR : all influenza A viruses**
  - Targets: matrix (2) & nucleoprotein genes
  - H5, HP & LP H5 (multiplex), H7, N1, and N8 genes
- Conventional: pan-HA, H6, N1, N2, H5, H7
- Also HP/LP H5/H7 : pathotyping PCR (H5) & HA0 characterization (Sanger sequencing)
- Full genome: NGS (ABI Genetic Analyzer 3130; Illumina MiSeq)

AIV RT-qPCR tests done



2016	2017	2018	2019	2020	2021	2022	2023
LP H7N7 ost	HP H5N8	HP H5N8	H6N2	H6N2	HP H5N1	HP H5N1	HP H5N1
H9 ost	LP H5N2 ost	H11N1 ost		LP H7N1 ost	LP H5N2 ost		HP H7N6
LP H5N2 ost	LP H5N2 ost			LP H5 ost			

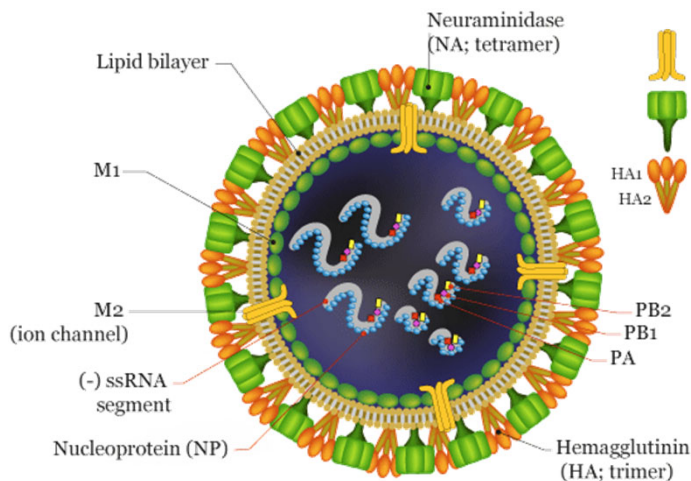


# Serology & Virus isolations

- Virology Lab: Dr A. Lubisi
- Large-scale screenings of chicken and ostrich sera :
  - Multispecies ELISA
  - HI tests for subtype determination
- Virus isolations in embryonated chicken eggs

# AI BACKGROUND

- Galliforms most susceptible .
- Severe disease with HP H5 or H7 AI :
  - Chickens, Turkeys, Quails, Guinea fowl,
  - Two main categories of H5 & H7 according to the severity of the disease in poultry:
    - low pathogenic (LPAI) strains-few or no clinical signs in poultry,
    - highly pathogenic (HPAI) strains, severe clinical signs, high mortality rates
- Presence of polybasic cleavage site



- Until recently, 16 H subtypes & 8 N subtypes
- Presently: 18 H and 11 N
- 2 new H & N bat subtypes, with different H receptor binding properties



# Natural reservoirs

- **Wild aquatic birds** Anseriformes (ducks and geese) and Charadriiformes (gulls and shorebirds)
- Host a large, genetically diverse range of IAVs
- Near perfect relationship that has evolved over a long time period
- Many **migrate** over vast distances



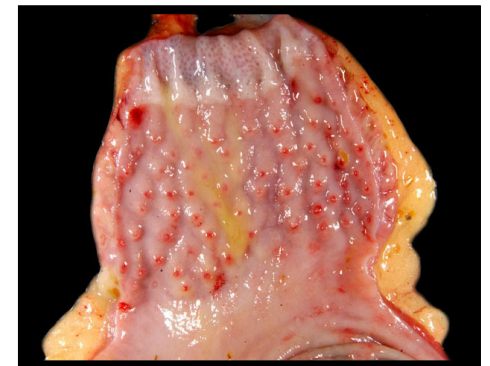
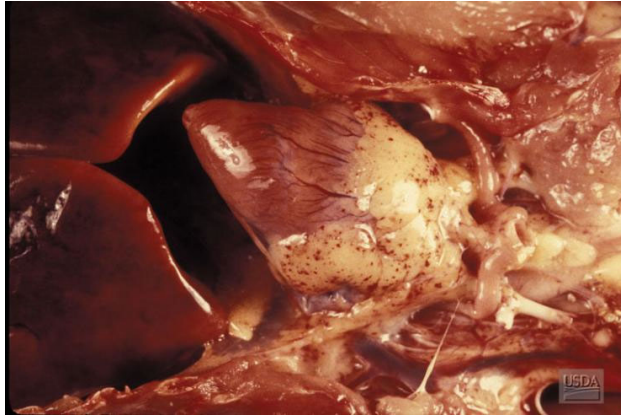
# Host-specific lineages

- Limited number of host-specific lineages
  - Wild aquatic birds (all subtypes)
  - Humans (H1 and H3)
  - Pigs (H1N1, H1N2 and H3N2)
  - Horses (H3N8; H7N7- extinct)
  - Dogs (H3N8)
  - Seals and whales
  - Domestic poultry (H9N2, possibly others e.g. H6N2, H3N2)

# HPAI Symptoms and lesions

One or more :

- Sudden death
- Depression and anorexia
- Decreased egg production
- Soft-shelled or misshapen eggs
- Swelling of the head, eyelids, comb, wattles, and hocks
- Purple discoloration of the wattles, combs, and legs
- Petechiations, ecchymoses: serosal surfaces, proventriculus....
- Nasal discharge
- Coughing, sneezing
- Lack of coordination ; drooping wings; paralysis; opisthotonus/torticollis; tremors
- Diarrhoea



# LPAI

- Can be asymptomatic , but with secondary pathogens mild to moderate disease commonly occurs
- Low mortality <5% and higher with secondary infections or in juveniles
- Respiratory signs, reduced egg production, lethargy, mild weight loss, diarrhoea
- PM: rhinitis, sinusitis, air sacculitis, peritonitis, pneumonia, swollen kidneys



# Ostriches

- Major farming region: semi-arid Klein Karoo
- Extensive nature; continual risk of introductions
- Disease severity depends on stress factors, management, immune status
- Multiple outbreaks: LP & HP H5N2, HP H5N8,
- LP H7N1 & H7N7 etc



# Differential Diagnoses

*Sudden onset of disease accompanied by high mortality, or signs of haemostasis in wattles and combs, oedema, haemorrhages, nervous signs, etc*

- Velogenic Newcastle disease / Pigeon paramyxovirus
- Infectious laryngotracheitis (chickens)
- Duck plague (anatid herpesvirus-1)
- Acute poisonings - pesticides; lead
- Botulism
- Acute fowl cholera (Pasteurellosis) and other septicaemic diseases
- Bacterial cellulitis of the comb and wattles
- Chlamydia psittaci
- Flaviviruses – WNV, Uhutu, Bagaza, TMEV, Ntaya....
- Less severe forms of HPAI clinically confusing
- Quaranja: Wellfleet Bay, Cygnet River, Johnston Atoll, Quarafil

# Transient transmission to other species

- Occurs relatively frequently
  - Sea mammals
  - Mink
  - Pigs



- But usually transient and permanent lineages are rarely established

# A/goose/Guangdong/1/1996 H5N1

- In 1996: emergence of Asian lineage of HPAI H5N1
- Spread throughout much of Asia, Europe Middle East, Africa (not southern)
- Multiple reassortments have occurred, yet retained original N1
- 2008: Clade 2.3.4.4. emerged in China;
- 2013-2015: explosive spread amongst birds



# Emergent characteristics of H5N1

- Direct transmission from wild birds to humans reported
- Transmission from domestic poultry to wild birds
- Increased tracheal shedding in wild birds
- Increased thermostability
- Nonpathogenic to highly pathogenic for waterfowl
- Endemic state in waterfowl (?)
- Transmission to felids and stone martens
- Emergence of at least 3 clades

# H5Nx

- Multiple genetic reassortments of Clade 2.3.4.4 with various LPAIs
- Pairing with new N subtypes: N2, N3, N5, N6 and N8
- H5N6 spread in Asia; H5N8 spread to Europe and N. America
- 2016: second panzootic spread of H5N8
- Now also causes deaths in many duck & wild bird species



- Spread of HPAI through high production poultry farming, bird, product and human movements
- HPAI H5Nx have aggressively spread via migratory birds
- Appear to be more transmissible ; more stable
- Changes in HA receptor-binding domain (now, apparently also fucosylated sialosides)
- Zoonotic potential less likely, or...?

# AI OUTBREAKS IN SA

	2004	2006	2011	2012	2017	2018
LPAI H5N2						
HPAI H5N2						
LPAI H7N1						
H9N2						
<b>HPAI H5N8</b>					  	 

\* H6N2 ongoing infection in chickens

# 2017/18 HPAI H5N8 OUTBREAK IN SOUTHERN AFRICA

- 26 May 2017, positive case from Zimbabwe
- 19 June 2017, first case of HPAI confirmed in Mpumalanga.
- A number of other poultry and ostrich operations, as well as wild bird species, aviculture and zoological collections infected with HPAI H5N8 since index case.
- Up to 1 March 2018, 155 locations tested positive for HPAI H5N8, reported to World Organisation for Animal Health (OIE).
- One of nine provinces, Northern Cape Province, unaffected

# HP H5N1

- April and May 2021, - several outbreaks of highly infective avian influenza (H5N1) in different poultry farms

# 2023 HPAI outbreaks in South Africa

- > 20% of South Africa's chickens died, or were culled
- The two largest chicken producers, lost more than R335m,
- Poultry losses ~ 12.3 million within a year
- Devastating for South Africa
- Estimated overall losses > R 2 billion
- No evidence of human infection



# 2023: HP H7N6

- From June 2023
- >50 HPAI H7 outbreaks and > 10 HPAI H5 outbreaks reported.
- Gauteng ( 37), Mpumalanga (2), Limpopo (2), Northwest (2), Free State (1)

- 7.5 million broilers and layer chickens culled between April and September 2023.
- Twenty-two H5 outbreaks
- Fifteen H7 outbreaks reported the World Organization for Animal Health (WOAH) as of November 2023.



# Vaccination

- DALRRD decided to allow this in 2023
- Targeted vaccination, strictly controlled only against H5N1 eg for breeders.
- Disease protection possible but not necessarily protection against infection.
- Will not be effective against H7N6
- H7 vaccine still awaiting approval
- Ongoing surveillance needed (costly)

# Acknowledgments

- Dr L. Rotherham — further molecular characterisations
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THANK YOU