Testing and contact tracing in support of control of an outbreak

Preparing for containment and mitigation of pandemic H5N1 influenza

Uses of Statistical and Mathematical Modeling

Thursday, 14 November 2024
13:00 to 18:00 Central European Time (CET)

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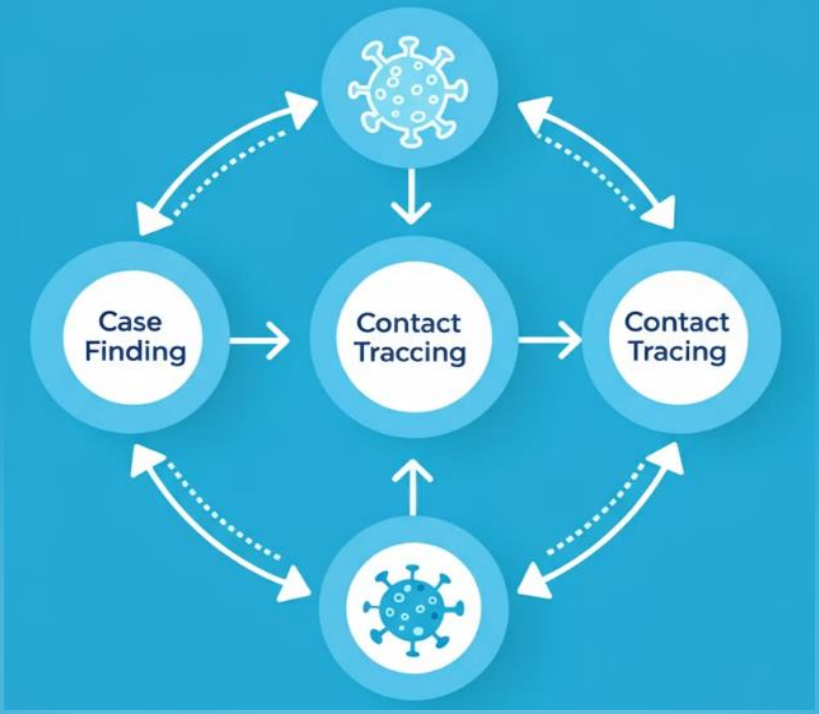

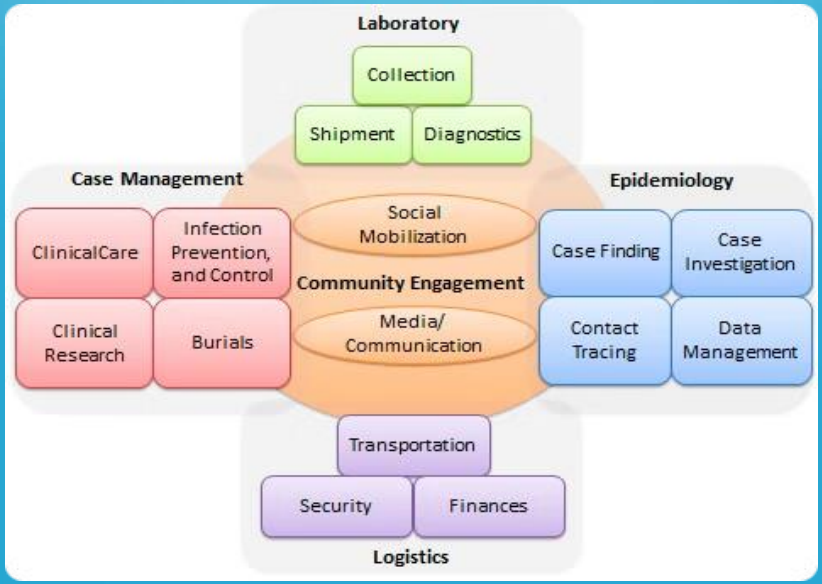

Implementation of contact tracing

1

Case Investigation

Thorough investigation of confirmed cases to identify contacts and potential transmission routes.

2

Contact Listing

Creating a comprehensive list of individuals who have been in close contact with confirmed cases. Eligibility for vaccination (e.g., Ring strategy) for limited doses available setting.

3

Contact Follow-up

Daily monitoring of contacts to assess their health status and provide support.

4

Management of Symptomatic Contacts

Immediate isolation and testing of contacts who develop symptoms compatible with the disease.

5

Contact Discharge

Discharging contacts from follow-up after incubation period if they remain asymptomatic.

Ref. https://iris.who.int/bitstream/handle/10665/185258/WHO_EVD_Guidance_Contact_15.1_eng.pdf;jsessi

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Case definitions & general considerations for contact tracing

1 Case definitions

H5N1 case definitions should be **clear**, **adaptable**, and cover **who**, **when**, **where**, and **how**. Include confirmed cases (**lab evidence**), suspected cases (**symptoms** and **exposure**), and probable cases (**clinical signs**, **epidemiological links**).
Define contacts as those **exposed** to confirmed or probable cases.
Regular updates, clear communication, and consistent application are essential for effective public health response.

2 Community Engagement

Community involvement in planning and implementation is crucial for building trust and ensuring cooperation.

3 Sensitive Communication

Culturally sensitive language is essential to prevent stigma and encourage participation in contact tracing.

4 Confidentiality

Protecting individual privacy is crucial for maintaining trust and encouraging contact tracing participation.

5 Psychosocial Support

Providing psychosocial support to individuals and communities can help address fear and anxiety associated with the outbreak.

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Ref. https://iris.who.int/bitstream/handle/10665/185258/WHO_EVD_Guidance_Contact_15.1_eng.pdf;jsessi

Planning and preparation for contact tracing

Infrastructure

Establish a robust incident management framework, an alert system, isolation units, laboratories, and treatment facilities.

Personnel

Recruit and train qualified personnel for contact tracing, case management, social mobilization, and logistics.

Resources

Acquire and stockpile essential equipment, supplies, MCM (e.g., vaccines and medications) for contacts and tracing team and case management.

Funding

Secure adequate funding to support all aspects of the outbreak response, including contact tracing.

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Ref. https://iris.who.int/bitstream/handle/10665/185258/WHO_EVD_Guidance_Contact_15.1_eng.pdf;jsessi

Contact tracing management

Database Management	Electronic databases facilitate data collection, analysis, and reporting.
Quality Assurance	Regular monitoring and supervision of contact tracing activities to ensure accuracy and effectiveness.
Quality Indicators	Tracking key metrics such as the percentage of contacts traced and followed up, and the number of new cases arising from registered contacts etc.
Personnel Management	Recruiting, training, and providing health and safety precautions and supporting contact tracing staff to ensure their safety and effectiveness.
Scalability	Planning for the expansion of contact tracing efforts to meet the demands of a potential increase in cases or contacts.

Ref. https://iris.who.int/bitstream/handle/10665/185258/WHO_EVD_Guidance_Contact_15.1_eng.pdf;jsessi

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Lessons for efficient and ethical H5N1 pandemic contact tracing

Digital Tools

Mobile apps using encrypted Bluetooth/GPS systems can quickly identify and notify exposed individuals while protecting user privacy.

Local Capacity Building

Training local health workers ensures effective manual tracing and facilitates community trust, a lesson learned from Ebola and COVID-19.

Data Integration

Comprehensive databases combining laboratory results and epidemiological data can streamline outbreak management.

Voluntary Isolation and Support

Providing medical and social resources during isolation improves compliance and upholds ethical standards.

1. https://www.adalovelaceinstitute.org/blog/contact-tracing-apps-uk/
2. https://www.researchgate.net/publication/353561171_Flashback_and_lessons_learnt_from_history_of_pandemics_before_COVID-19
3. https://ieg.worldbankgroup.org/blog/lessons-ebola-fight-against-covid-19-coronavirus

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Contact tracing for H5N1 response

1 High-Risk Areas

Focus on tracing and monitoring close contacts of confirmed cases in high-risk areas such as poultry farms, mammals, including dairy cattle or live animal markets.

2 Digital and Manual Tracing

Combining digital tools with manual tracing methods to ensure comprehensive coverage (phone calls etc.).

3 Close Monitoring

Regular follow-up of contacts to assess their health status and provide support to mitigate secondary transmissions.

1. https://www.cdc.gov/bird-flu/spotlights/h5n1-low-risk-public.html
2. https://chatgpt.com/c/6727e6b6-fd74-8007-bbd3-f56cf317af17#:~:text=emerge%20%5B2%3B-,1,-%5D.

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Ethical considerations in H5N1 tracing

1

Privacy Protection

Data anonymization and strict usage limits are essential to protect privacy in contact tracing. Data must be used solely for public health purposes and not shared with third parties without consent.

2

Support for Isolated Contacts

Providing medical, social, and financial support (if needed) is crucial to encourage voluntary self-isolation, including access to healthcare, mental health services, and other essential resources.

3

Transparency and Communication

Clear communication about contact tracing's purpose, methods, and benefits builds public trust and encourages participation. Transparency on data use and privacy is crucial.

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Testing considerations for H5N1

1 RT-PCR Testing

Enables precise identification of H5N1 in symptomatic individuals and at-risk populations. and targeted areas during outbreaks. A One Health approach should be considered too.

2 Mobile Testing Units

Critical for reaching underserved or rural areas.

3 Antibody Testing

Testing individuals previously vaccinated with pre-pandemic H5 vaccines can help assess immunity levels and inform public health responses.

4 Antigen Testing

Offers quick preliminary screening to focus resources.

1. https://pmc.ncbi.nlm.nih.gov/articles/PMC10145843/
2. https://www.cdc.gov/bird-flu/situation-summary/what-cdc-doing-h5n1.html

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Insights from COVID-19 contact tracing in High-Income Countries

1 Digital Applications

Bluetooth-enabled apps was used in **South Korea**, **Germany**, and **Singapore** enabled rapid exposure notification.
While **Taiwan** used GPS to identified contacts of cases.

2 Comprehensive Strategies

Combining digital tools with extensive testing and manual tracing ensured coverage even in populations without app access.

3 Centralized Systems

Integrated health databases streamlined real-time contact tracing efforts and outbreak monitoring.

Ref. https://pmc.ncbi.nlm.nih.gov/articles/PMC9997056/

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UK case study on contact tracing

1

NHS Test and Trace

Combined manual (physical and phone calls) and digital tracing supported by widespread testing .

2

Digital Tools

The NHS COVID-19 app alerted users of exposure using Bluetooth. Venue check-ins provided additional tracking.

3

Feedback and Improvements

Public feedback refined tracing systems, addressing adoption and literacy challenges.

1. https://www.gov.uk/government/publications/technical-report-on-the-covid-19-pandemic-in-the-uk/chapter-7-contact-tracing-and-isolation#:~:text=In%20addition%2C%20particular%20venues%20were,to%20the%20COVID%2D19%20app.
2. https://www.adalovelaceinstitute.org/blog/contact-tracing-apps-uk/
3. https://www.sciencedirect.com/science/article/pii/S2666535223000472

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Practical implementation steps for H5N1 contact tracing

1 Develop Digital Tools

Create mobile apps for real-time contact data collection and user notifications.

2 Enhance Data Sharing

Establish centralized platforms accessible by labs and health authorities for streamlined tracking.

3 Engage Communities

Conduct workshops for local health workers and community leaders to promote effective tracing.

4 Support Isolated Contacts

Ensure access to medical care and necessities for quarantined individuals to foster compliance.

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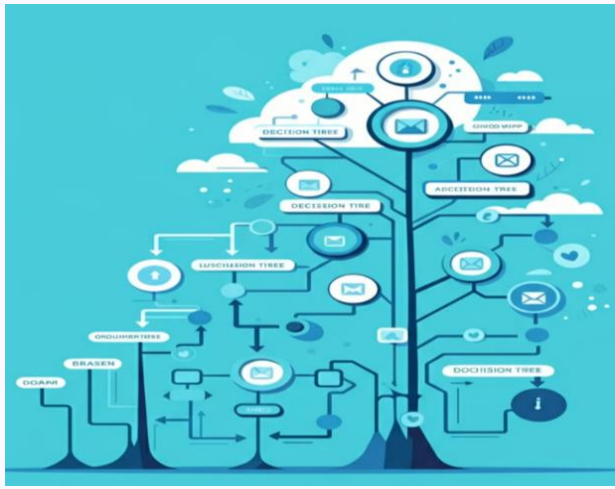
Adaptations for resource variability in testing and tracing

Setting	High-Resource	Low-Resource
Testing	Wide RT-PCR testing, including mobile units. Digital data platforms for real-time results.	Prioritize testing symptomatic individuals and close contacts with rapid antigen tests, using manual result dissemination where digital tools are unavailable.
Contact Tracing	Digital apps, Bluetooth-enabled contact tracing apps linked to national health databases with teams supporting user compliance.	Train local health workers for manual tracing using paper forms or basic mobile tools for contact recording and follow-up.
Community Engagement	Multimedia campaigns educate on symptoms, testing, and isolation, supported by hotlines and websites for self-reporting and information access.	Collaborate with local leaders and organizations to raise awareness using radio, meetings, and posters for widespread health messaging.
Surveillance Systems	Create digital platforms integrating testing, tracing, and vaccination data for detailed epidemiological insights.	Create a centralized reporting system to aggregate clinic data and use periodic reports to refine interventions.

1. https://www.mdpi.com/2504-2289/6/4/111
2. https://www.sciencedirect.com/science/article/pii/S2666691X21000282

AI-Powered case definitions for H5N1 pandemic response

A suitable model for this purpose could be as many other model an **ensemble learning model**, combining **gradient boosting decision trees** (e.g., XGBoost) for prediction accuracy and **neural networks** for handling complex patterns in data.



1 Data Integration

Patient data, including demographics, symptoms, comorbidities, and contact history, is gathered from surveillance, healthcare facilities, and real-time reporting..

2 Feature Engineering

Transform input data to relevant features such as proximity to outbreak epicenters, symptom severity scores, and risk factors.

3 Training and Validation

Gradient boosting trees analyze structured data for risk scores and thresholds for suspect cases, while neural networks process unstructured data (e.g., clinical notes). to identify patterns

4 Model Outputs

The model classifies individuals as confirmed, probable, suspect, or contacts based on criteria, known symptoms, or new ones, assigning a probability score to support triage, resource allocation, and minimizes potential delays in critical decision-making.

5 Real-Time Updates

Models continuously refine definitions using active learning from new patient data (emerging symptoms or risk factors) and epidemiological patterns.

1. https://www.nature.com/articles/s42003-024-06629-0
2. https://pmc.ncbi.nlm.nih.gov/articles/PMC7883226/

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Conclusion

By integrating these **strategies** and **tailoring** them to **specific contexts**, public health responses can improve **H5N1** outbreak **containment and management**. AI-powered case definitions offer a **promising avenue** for enhancing pandemic preparedness and response, enabling faster and **more accurate identification** of cases and contacts, ultimately contributing to a **more effective** and **efficient control** of H5N1 **outbreaks**.

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