

# **Pandemic Influenza and the Blood Supply - A Study Proposal**

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# Introduction

## Pandemic Influenza

- Reassortment ► antigenic shift
  - Mixed infections
  - Mixing vessels
- Direct jumping cross species
  - Avian influenza
  - Highly pathogenic avian influenza
  - H5N1
  - Others?

# Introduction

## Pandemic Influenza (con't)

- Pandemic potential of existing avian viruses in humans
  - Can directly infect humans
  - Transmission from human to human inefficient
  - Existing avian viruses have low pandemic potential
- The risk
  - The virus mutates rapidly, can cause severe diseases in humans
  - Further mutation of current H5N1
  - Adaptation to efficient transmission among humans

# Introduction

## The Blood Supply

- The American Red Cross Blood Services
  - 35 regions across the country
  - Over 4 million donors annually
  - Donate approximately 7 million blood units
- Challenges to the Blood Supply
  - Safety
  - Availability, especially in difficult times (winter/summer) and for certain products
  - Contingency planning and accommodation:
    - Following 9.11 attack
    - Other events that may affect supply and demand

# What could happen to the blood supply when a pandemic influenza occurs?

## Potential Impact on Safety:

- Viremia may occur among infected individuals
- Chance may be low in asymptomatic infections
- Normal route of transmission – respiratory tract
- Potential impact on blood safety should be small but may not be zero

# What could happen to the blood supply when a pandemic influenza occurs?

Potential Impact on Availability: Based on the CDC model (Meltzer, Cox & Fukuda, EID 1999;5:659-71)

- Assume an attack rate of 15% to 35%
- Assume no intervention
- Assume no self deferral by potential blood donors, no reduction in donation due to panic and unwillingness to come out and donate, and no additional deferral by FDA
- 8% to 19% of blood donors could be infected, 97% of whom would need no hospitalization

# What could happen to the blood supply when a pandemic influenza occurs?

Also apply the CDC model to blood supply workers:

- Assume an attack rate of 15% to 35%
- Assume no intervention
- Assume no reduction in reporting to duty due to panic and unwillingness to come out and work, and no additional loss due to quarantine by disease control authorities
- 8% to 18% of blood supply workers could be infected and could not report to duty (based on employee data from one region)

# What could happen to the blood supply when a pandemic influenza occurs?

Some of blood donors and blood supply workers may have to stay home to care for sick family members infected by influenza

More donors and workers may be unable to, be afraid of or unwilling to show up for various reasons

# What could happen to the blood supply when a pandemic influenza occurs?

In the transfusion recipients side:

- There could be reduced admission to hospitals and hence reduced needs for transfusion
  - Impact of pandemic flu – how much if at all?
  - Delayed elective surgery
- There could also be reduced needs for transfusion among hospitalized patients due to cancellation or postponement of surgeries etc.
  - Delayed elective surgery
  - Staff capacity reduction

## But...

- By how much will the reduced need for transfusion be, including for different components?
- By how much will staff absenteeism affect the blood supply?
- By how much will various factors affect donors' donations:
  - Donor demographics, collection sites, sponsoring groups, etc.
- How much impact will different intervention options have on blood availability?

# What Is Needed?

- A model that incorporates the many unique aspects of the blood supply system, including
  - Blood donors/donations and donor deferrals
  - Blood donation collection, screening, processing and delivery
  - Staff attendance and production capacity
  - Recipients and their transfusion needs for different components
  - Mitigation efforts such as inter-region transfer of certain products
  - Platelet need, availability and platelet apheresis collections

## What Is Needed?

- A model that allows readily assessment of impact of changes in various elements that may affect supply or demand and assessment of intervention options
  - Antivirals
  - Vaccination
  - Provision of care for sick family members of key blood supply workers
  - Reduced admission of certain patients to hospitals
  - Postponement or cancellation of certain medical procedures
  - Additional donor deferral options

# A Study Proposal

## I. Development of a model for the blood supply system

- Based on widely available software
- Based on existing data from ARC and other sources
- Have multiple components yet linked to each other
- Validated through testing in different populations

**US General Population: gender, age, race, education and others**

x proportion to present for donation  
x blood drive type, sponsor type, staff capacity

**Blood Donor Population: demo, first/second-time, regular, lapsed**

x proportion of deferral, donation frequency, different components  
x proportion of loss, staff capacity, transportation etc.

**Blood Components Available: different region, season etc.**

**Patients' Need for Transfusion: demo, disease, procedure**

x proportion of transfusion, different components, staff capacity  
x proportion that can be cancelled or postponed

**Balance of Blood Supply/Demand: components**

# A Study Proposal

- **Example: elements of the blood donor component of the model**
  - Gender, age, race, education, ... composition of the US population
  - Blood donation rates of those different categories
  - Changing pattern over time (seasonal and long-term) in donation rate for different categories
  - Composition of first-/second- time, repeat, regular donors, retention rates, donation frequency
  - Blood drive type and sponsor type
  - Staff capacity: gender, age, contingency capacity especially for key operational units
  - Donor health history deferral rates of those different donor categories
  - Donor ID marker positive deferral rates of different categories
  - Impact entry for reduced presentation during a crisis such as a pandemic flu

# A Study Proposal

- **Example: elements of donor medical exam and health history deferral component:**
  - Donation interval: to incorporate possible changes in the future
  - Physical deferral: temp, bp, pulse, weight, Hct, inspection of arms
  - Deferral for donor safety questions
  - Deferral for general blood safety questions
  - Deferral for specific bloodborne or sexually transmitted infection questions
  - Deferral for potential new or emerging threats for which there is no screening test
  - Deferral for other questions
  - Donor deferral periods for different deferrals
  - Changing pattern over time (seasonal and long-term) in deferral rate for different donor categories
  - Donor reaction following donation and related factors (iron etc)

# A Study Proposal

- **Example: elements of the recipient or blood demand component of the model**
  - Utilization of different blood components by recipients
  - Composition of recipients by demographics, disease categories, procedure categories
  - Impact entry for reduced admission or demand during a crisis such as a pandemic flu
  - Entry for proportion of transfusions that can be delayed or cancelled in a crisis such as a pandemic flu

# A Study Proposal

## II. Application of the developed model to assess the likely impact of pandemic influenza

- Dynamic nature of a flu pandemic
- Likely impact on both supply (donor and blood center) and demand (recipient and hospital)
  - Infection of blood donors
  - Further reduction of blood donation due to other reasons
  - Infection of blood supply workers
  - Further reduction of workers due to other reasons
  - Impact on transfusion needs by components
- Risk of transfusion transmission

# A Study Proposal

## III. Evaluation of intervention options

- To reduce attack rates: general public health measures
- To protect blood donors
- To protect blood supply workers: antivirals, vaccination and others
- To cancel or postpone certain transfusions
- To introduce new donor deferral options

## What Are Available

- General epidemiologic data on influenza
- Blood donor and donation data
- Blood donor deferral data
- Donation management and staff capacity
- Utilization of blood products data - HCUP
- Experience with related diseases such as SARS
- Research results on health care providers

## What's Next

- To organize a working group on pandemic influenza and the blood supply
  - Blood bankers, epidemiologists, modeling researchers
- To lay out a modeling framework
- To seek advice and comments from relevant experts on the framework and to optimize the model design
- To model the blood supply system, followed by likely impact of pandemic flu and of various factors and intervention options

# Expected Results

- A blood supply system model
  - Reflecting the entire process from potential donor to recipient, including major influencing factors or elements
  - Can be used to assess effectiveness and impact of intervention options
  - Can be applied, with necessary modifications, to other emerging, potentially bloodborne pathogens or other threats to the blood supply in the future
- Estimated impact of pandemic influenza on the blood supply

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