

Isolation and Quarantine for the interruption of infectious disease outbreaks



General approaches to control of communicable diseases

1. Enhance host resistance to infection

- ❖ Active immunization (e.g., diphtheria and tetanus toxoids)
- ❖ Passive immunization (e.g., diphtheria immune globulin, tetanus immune globulin)
- ❖ Improved nutrition

General approaches to control of communicable diseases (cont.)

2. Interrupt transmission of infectious agents

- ❖ *Detect, treat cases (screening, contact tracing)*
- ❖ *Isolation and quarantine*
- ❖ Pre- and post-exposure chemoprophylaxis
- ❖ Vector control
- ❖ Environmental (habitat) control
- ❖ Aseptic technique
- ❖ Sanitation and water purification
- ❖ Food hygiene
- ❖ Remove susceptibles by culling (veterinary only!)

General approaches to control of communicable diseases (cont.)

3. Personal measures

- ❖ Personal hygiene
- ❖ Protective barriers (infection control)
- ❖ Avoidance (abstinence, travel restrictions)

Definitions - *Isolation*

- Separation and restricted movement of *ill* persons with contagious disease – infectious
- Often in a hospital setting
- Primarily individual level, may be populations
- May be voluntary or mandatory
- Usually lasts for the period of communicability of the illness, which varies by disease and the availability of specific treatment

Definitions - Quarantine

- Separation and restricted movement of **well** persons presumed exposed to contagion – not yet infectious, until exposed person becomes ill or the incubation period has passed.
- May be voluntary or mandatory
- Quarantine can be at various levels:
 - ❖ Individual – often at home, may be a designated residential facility
 - ❖ Facility
 - ❖ Community (*cordon sanitaire*) – geographic isolation of an area where an outbreak is occurring
 - ❖ National (border closures)
- Origin
 - ❖ In the 14-15th centuries, Venice imposed a harbor quarantine (from the Italian “quaranta,” – the 40 day period during which arriving ships were detained) to control the spread of plague.

Objectives

- Isolation

- ❖ Protect community and patients by removing and separating infectious patients from susceptibles

- Quarantine

- ❖ Facilitate early recognition of a contagious disease should they develop
- ❖ Reduce risk of transmission before progression to disease has been recognized

US Federal isolation and quarantine authorized for these diseases

- Cholera
- Diphtheria
- Infectious tuberculosis
- Plague
- Smallpox
- Yellow fever
- Viral hemorrhagic fevers
- Severe acute respiratory syndromes
- Flu that can cause a pandemic

Challenges

While quarantine and isolation can help to prevent spread of disease as well as population panic during outbreaks, their application is challenging:

- Individual liberty vs. societal protection
- Economic implications
- Incomplete information about agents, risks
- Communication
- Implementation and enforcement of a coordinated response with limited health infrastructure and staff
- Social and economic needs of those being restricted
- Prospective tracking, and data management systems

General approach to estimating effect of quarantine

- **Simulation studies** – results driven by prior assumptions, difficult to capture complexity and heterogeneity in behavior, human networks, adherence with control measures. Model results not widely familiar to health policy makers
- **Case studies** – plot the epidemic curve of cases across a timeline of events and changes in public health response. Rich in contextual information. Drawing inference from these curves suits only point-source outbreaks, and amount to one group pre-test post-test designs, providing weak evidence for causation.
- **Reporting on process measures:** Effect of quarantine on shortening time from onset of symptoms to isolation; Proportion of SARS cases who developed symptoms under quarantine; Proportion of individuals quarantined who developed SARS
- **Reporting on effect of control interventions** – generally examined pre-post in relation to subsequent changes in the reproductive number

Methodological challenges to estimating effects of quarantine

- Randomization to quarantine not considered ethical
- Comprehensive quarantine may eliminate any control arm
- Selection bias related to health status, employment, family structure and other factors may confound the association between quarantine and observed transmissions
- Measurement errors:
 - ❖ False positives
 - ❖ Number of contacts at risk may be biased towards those where transmission already happened.
- Best possible observational design would permit evaluation of the decision made by public health official to place individual under quarantine and apply analyses based on both intention-to-treat as well as take compliance into account

Statistical challenges to estimating effects of quarantine

- Statistical power because of small samples, therefore analytic procedures assuming large samples tend to overstate precision relative to bootstrap
- Unit of analysis relative to the intervention: Usually we think of measuring an outcome in the same individuals assigned to a treatment. In quarantine, the intervention is applied to an individual, but all potential benefit is to other persons
- Many lack familiarity with statistical methods for count data