

HARNESSING THE POWER OF INFECTIOUS DISEASE INFORMATION WITH A RELATIONAL DATABASE

Presenter Disclosures

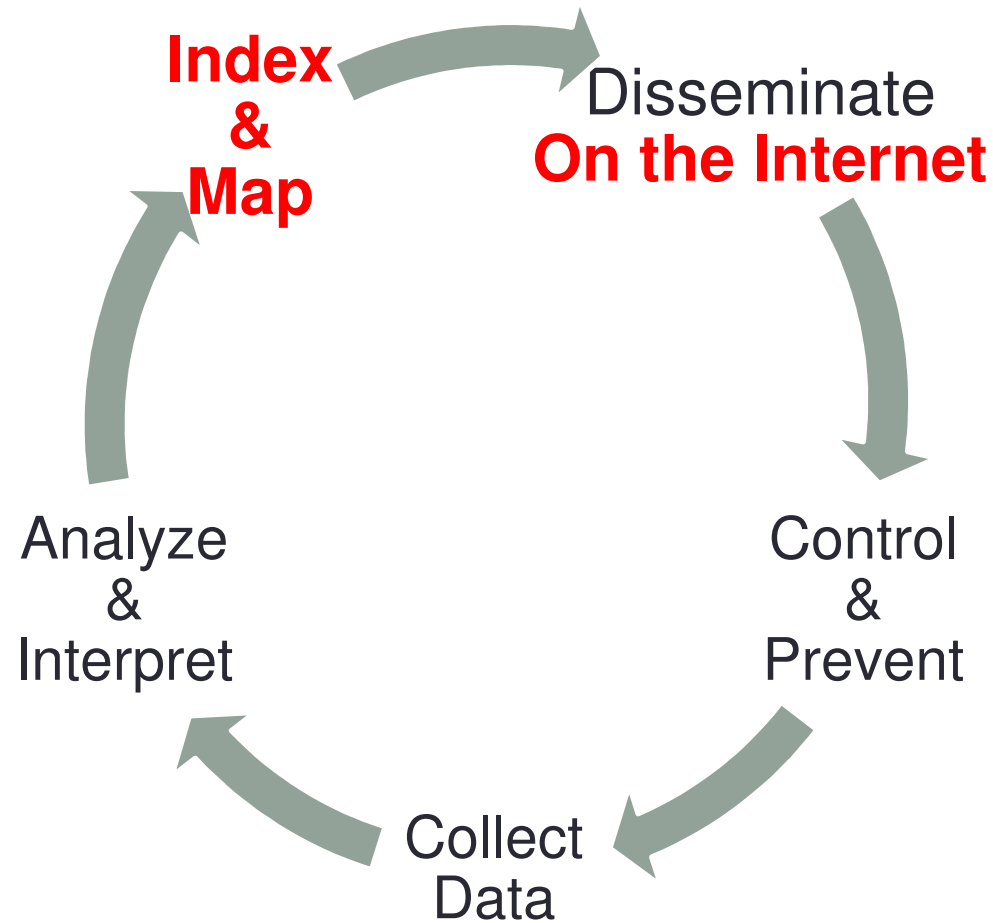
I developed “IDdx: Infectious Disease Queries” which is currently a free download from *Apple Store (iPhone or iPad)* and *Google Play (Android phone)*.

Presented by

Jay A. Brown, MD, MPH
Consultant for the U.S.
National Library of Medicine

Using infectious disease information is an important priority in global public health.

Medical Surveillance and Prevention





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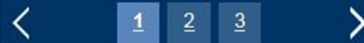
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Contact Us:

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VACCINES. MEDICINES. ADVICE.

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What kind of traveler are you?
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For Clinicians



Destination

-- Select One --

Special population(s)
(optional)

Traveling with Children

Disease Directory

Learn more about travel-related diseases.

African Sleeping Sickness

Go



Before you travel make sure you speak with your doctor.



An outbreak of SARS in China can become an outbreak in Toronto a few days later.



A vast treasury of infectious disease
knowledge has been discovered in the last
150 years

Expert CONSULT

Mandell, Douglas, and Bennett's Principles and...

jaundice

Show: All 85 Results

Historical Background

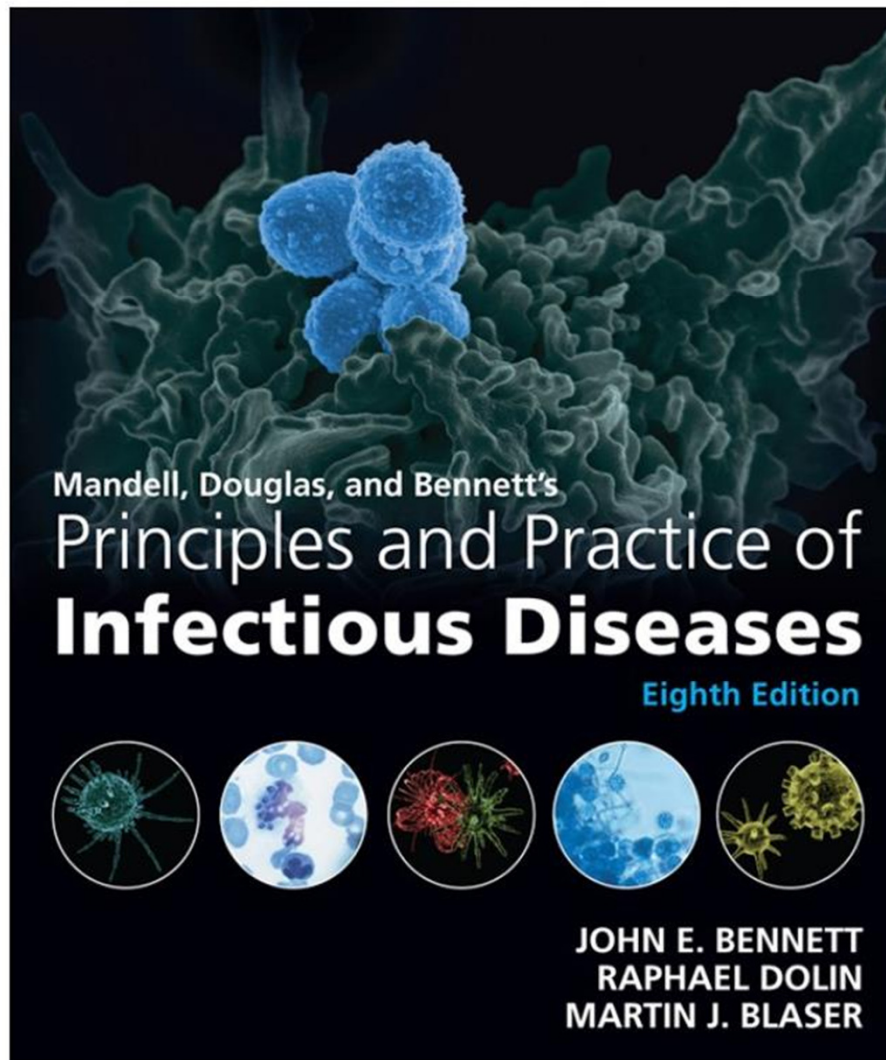
Historical Background The potential for bloodborne transmission of hepatitis B first was noted in 1885, when Lurman described **jaundice** in factory workers who had received smallpox vaccine prepared fro...


History

History A syndrome of severe multisystem disease, presenting with profound **jaundice** and renal function impairment, was described by Weil in Heidelberg in 1886. Other descriptions of disease that proba...

History

History The earliest accounts of contagious **jaundice** are from ancient China. 1 Although the symptoms that were described are similar to those currently found in people





This knowledge, summarized in *Control of Communicable Diseases Manual*, includes signs & symptoms, diagnostic tests, geographical occurrence, mode of transmission, incubation period, and risk factors.

Lyme disease

ID: 344

Find Disease

Agent Type:

Bacteria

Acute/Chronic:

Acute-Moderate

Category: Arthropod-Borne **Precautions:** Standard; "Not transmitted from person to person." [CDC 2007 Guideline]

Synonym: Lyme borreliosis; Tickborne meningopolyneuritis; Borrelia burgdorferi infection; Southern tick-associated rash illness (P)

Initial Symptoms: Erythema migrans (EM) is estimated to occur in 80% of infected patients within 30 days of exposure. "EM is a red, expanding rash, with or without central clearing." EM is often accompanied by flu-like symptoms. [CDC Travel, p. 227]

Comments: FINDINGS: A red macule or papule (erythema migrans) is the initial finding in 80% of patients. It appears at the site of the tick bite. In the classic presentation, the macule or papule expands concentrically with central clearing (annular shape), reaching a diameter of at least 5 cm. Regional lymphadenopathy may accompany the skin lesion. Lyme disease does not develop in experimental animals unless the tick has been attached for 24 hours or longer. The expanding skin lesion

Diagnostic: "Serological tests are poorly standardized and must be interpreted with caution." [CCDM] Diagnose clinically; Use paired sera in confusing cases; Acute serology negative in 30-70% of early infections. [ABX Guide] See Comments.

Scope: Throughout USA with most of cases in MA, NY, NJ, CT, RI, PA, MN, WI, CA, & OR; Also Ontario & British Columbia; Reported in Europe, Russia, China & Japan; [CCDM]

Incubation: 3 days to 1 month; average about 1 week;

Risk Factors

- Travel to endemic area
- Work or play in tick-infested area

Entry:

- Inhale Ingest Needle Skin/Eye Animal Bite Swim Sex
- Source:** Patient Fecal-Oral Fecal-Soil Excreta Tissue Soil
- Food Meat Fish Shellfish Dairy Edible Plant Water
- Vector:** Fleas Biting Flies Lice Mites Mosquitoes Ticks
- Reservoir:** Birds Cattle Cats Deer Dogs Fish
- Human Horses Monkeys Rabbits Rodents Swine Wild
- Travel Outside U.S.** **Immunocompromised at Risk**

"The presence of erythema migrans following a tick bite in an area endemic for Lyme disease warrants empiric treatment" [EMCC 2014]

Antimicrobial:
Vaccine:

- WBC+ Seizure Cough Splenomegaly
- WBC- Paralysis Infiltrate Abd. Pain
- EOs Stiff Neck Hemoptysis Diarrhea
- LFTs Vision- Shock Rash on Palms
- Platelet- Anemia Sepsis Vesicles
- Warfare Agent**

- Signs and Symptoms**
- >arthralgia
 - >fatigue, weakness
 - >fever
 - >myalgia
 - E pharyngitis
 - G liver function test, abnormal
 - G nausea, vomiting
 - H lymphadenopathy
 - H splenomegaly
 - N headache
 - N paresthesia
 - N seizure
 - N stiff neck
 - O conjunctivitis, acute
 - R chest pain
 - R cough
 - R dyspnea
 - S cellulitis or rash, circinate
 - S entry wound with lymph nodes
 - S papules or plaques
 - S petechiae and ecchymoses
 - S pustule

- Aus E.As India S.E.As N.Am C.Am Trop.S.Am Temp.S.Am N.Af S.Af W.Af C.Af E.Af ME W.Eu USSR

Latency: 0-6 hrs 7-24 hrs 24-48 hr 2-14 days 2-8 wks 2-24 mo >2 yrs **Global:** 102,000 **US:** 33,097

Drug Link: [CDC-Lyme Disease](#)

Global Stats: Most cases in Europe are reported in the mid-continent and in Scandinavia; [Harrison ID, p. 721] Cases reported in England & Wales: 863 (2009), 905 (2010), 959 (2011), 1040 (2012); Every year about 65,500 cases in Europe, >20,000 in US, 3,500 in Asia, and 10 in North Africa; [5MCC-2014] 65,500 + 3,500 + 33,000 = 102,000

US Stats: MMWR 2011;

Navigation Pane

Lyme disease

Category Arthropod-Borne

Agent Type Bacteria

Other Names Lyme borreliosis; Tickborne meningopolyneuritis; Borrelia burgdorferi infection; Southern tick-associated rash illness (Related Infection);


Acuity Acute-Moderate

Incubation 3 days to 1 month; average about 1 week;


Initial Symptoms Erythema migrans (EM) is estimated to occur in 80% of infected patients within 30 days of exposure. "EM is a red, expanding rash, with or without central clearing." EM is often accompanied by flu-like symptoms. [CDC Travel, p. 227]

Precautions Standard; "Not transmitted from person to person." [CDC 2007 Guideline for Isolation Precautions]

Comments FINDINGS:
A red macule or papule (erythema migrans) is the initial finding in 80% of patients. It

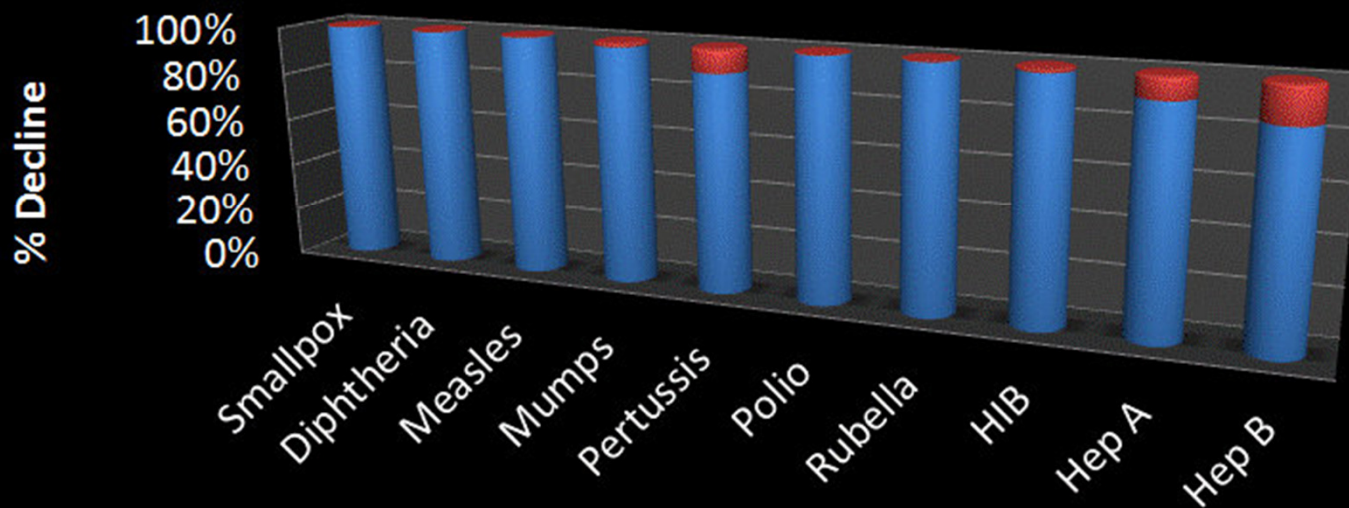


With the current availability of fast hand-held computers, the Internet, and easy-to-use relational database software, the stage is set for the eradication or control of many infectious diseases that have ravaged mankind for thousands of years.




“ . . . some diseases are close to being eliminated or eradicated completely, among them poliomyelitis, leprosy, neonatal tetanus, guinea-worm infection and Chagas disease.” [WHO]

Decline in Annual Cases of Vaccine-Preventable Diseases in US




	Smallpox	Diphtheria	Measles	Mumps	Pertussis	Polio	Rubella	HIB	Hep A	Hep B
After	0	0	61	2,528	21,291	0	6	270	11,049	11,269
Before	29,005	21,053	530,217	162,344	200,752	16,316	47,745	20,000	117,333	66,232




A properly designed and updated relational database of infectious diseases can serve as a decision-support tool for physicians and other healthcare professionals.



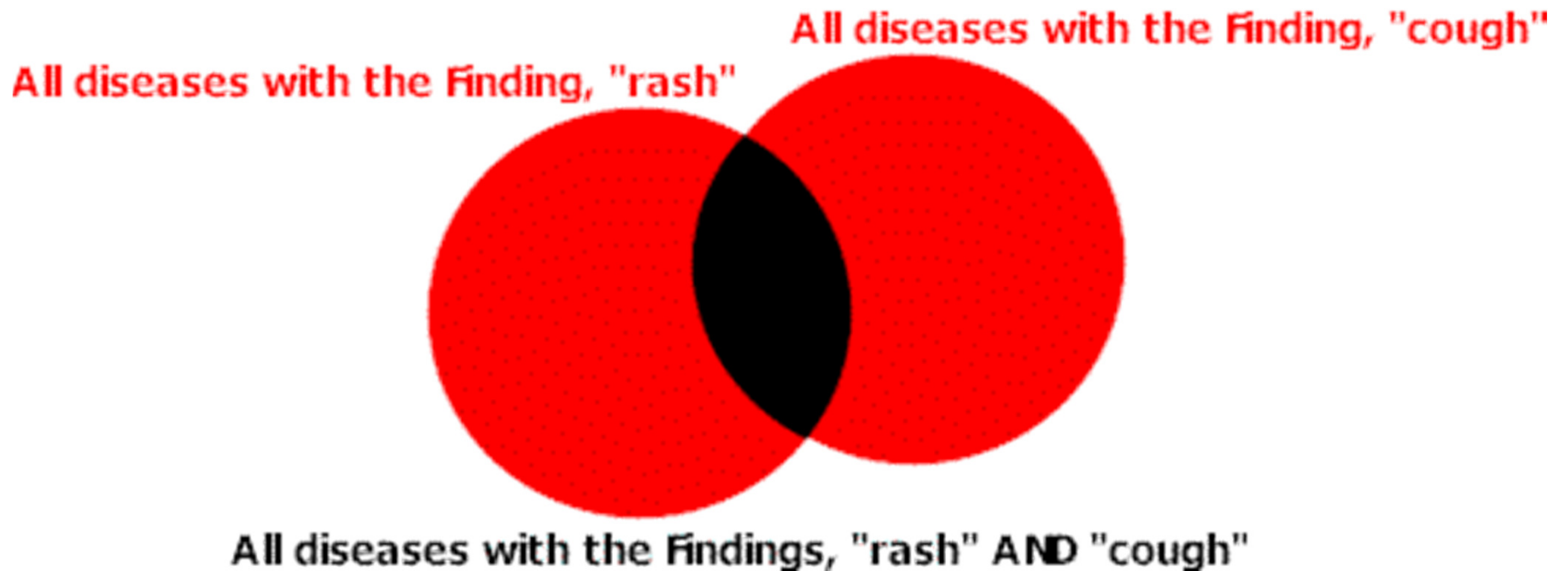



Information can be instantaneously updated for frontline doctors, who can query the database for all diseases that match specific symptoms, an occupation, a region of the world, or an insect vector.



The results of a query become a differential diagnosis list based on the criteria of the query.

How “AND” Queries Work





For example, the user can find that 7 of 249 diseases match the criteria of "jaundice" and "ticks."

Category >

Exclude Localized Infections ✕

Signs & Symptoms Match All >

G jaundice ✕

Epidemiological Factors Match All >

Ticks ✕

Endemic >

Incubation Period >

Occupation >

Acuity >

Other >

Clear All

Babesiosis >

Boutonneuse fever >


Crimean-Congo hemorrhagic fever >

Q fever >

Relapsing fever >

Rocky Mountain spotted fever >

Tularemia >



In summary, all useful infectious disease information can be collected and indexed into a relational database to help practitioners quickly build differential diagnoses and find details about specific diseases.

Some Examples of Search Criteria for Zoom-Intersection

FINDINGS	ENTRY	VECTOR	RESERVOIR
Abdominal pain	Inhale	Biting flies	Birds
Encephalitis	Ingest	Fleas	Cats
Pneumonia	Animal bite	Lice	Cattle
Jaundice	Needle	Mosquitoes	Dogs
Stiff Neck	Sexual	Ticks	Fish

APPENDIX

Medical Informatics Problem

1. There is an explosion of information about infectious diseases.
2. How can we find the specific information we need when we need it?

Public Health Informatics Solution

1. Use available technology.
2. Index and map the wealth of information.
3. Create an intelligent database to store the information in such a way that specific information can be easily retrieved.
4. Use the Internet and mobile Apps to disseminate the information for improvement of medical practice and prevention.

Relational Database: A New Tool for Indexing and Mapping Information

- Like a company database of employees, customers, products, and invoices, information is stored in tables that are linked together.
- Indexing is done first by developing a controlled vocabulary specific for the knowledge domain.
- Queries allow finding information by search criteria (the indexes) including “OR” and “AND” searches.
- Categories are used to “drill down” to find information.

Indexing: At the Heart of Intelligence

- “Indexing is a major problem at the heart of intelligence.”
[Roger Schank. *Tell Me a Story*, p. 11]
- “No intelligent system is likely to function effectively if it cannot find what it knows when it needs to know it.”
[Schank, p. 112]
- Show all diseases that match one or more criteria:
 - Central Africa AND petechial rash;
 - Cat contact AND diarrhea;
 - Tick exposure AND anemia;

Indexes Used in IDdx

- Signs and Symptoms
- Endemic Regions of the World
- Epidemiological Factors
 - Entry
 - Source
 - Vector
 - Reservoir
- Occupations
- Incubation Periods

Sources of Information

- Best and most recent;
- Starting point is latest edition of *Control of Communicable Diseases Manual* (CCDM);
- Now available for full-text online access are CCDM, Principles and Practice of Infectious Diseases (PPID), Infectious Diseases (Cohen), and Tropical Infectious Diseases (Guerrant);
- Disease findings in IDdx were checked by doing text searches for each finding in each of the online books.

References in IDdx

- For a full list of all references used in IDdx, see the bibliography page at <http://www.iddx.com/bibliography.html>

Knowledge Mapping

- “Decision support systems can provide preliminary analysis that allows scarce human resources to focus on the key problems while ignoring a vast sea of irrelevancy.” [O’Carroll et al. 2003]
- Knowledge is information in context.
- Mapping means pulling together and sifting information from a lot of different sources.
- Knowledge mapping is comprehensively collecting and systematically indexing a knowledge domain.

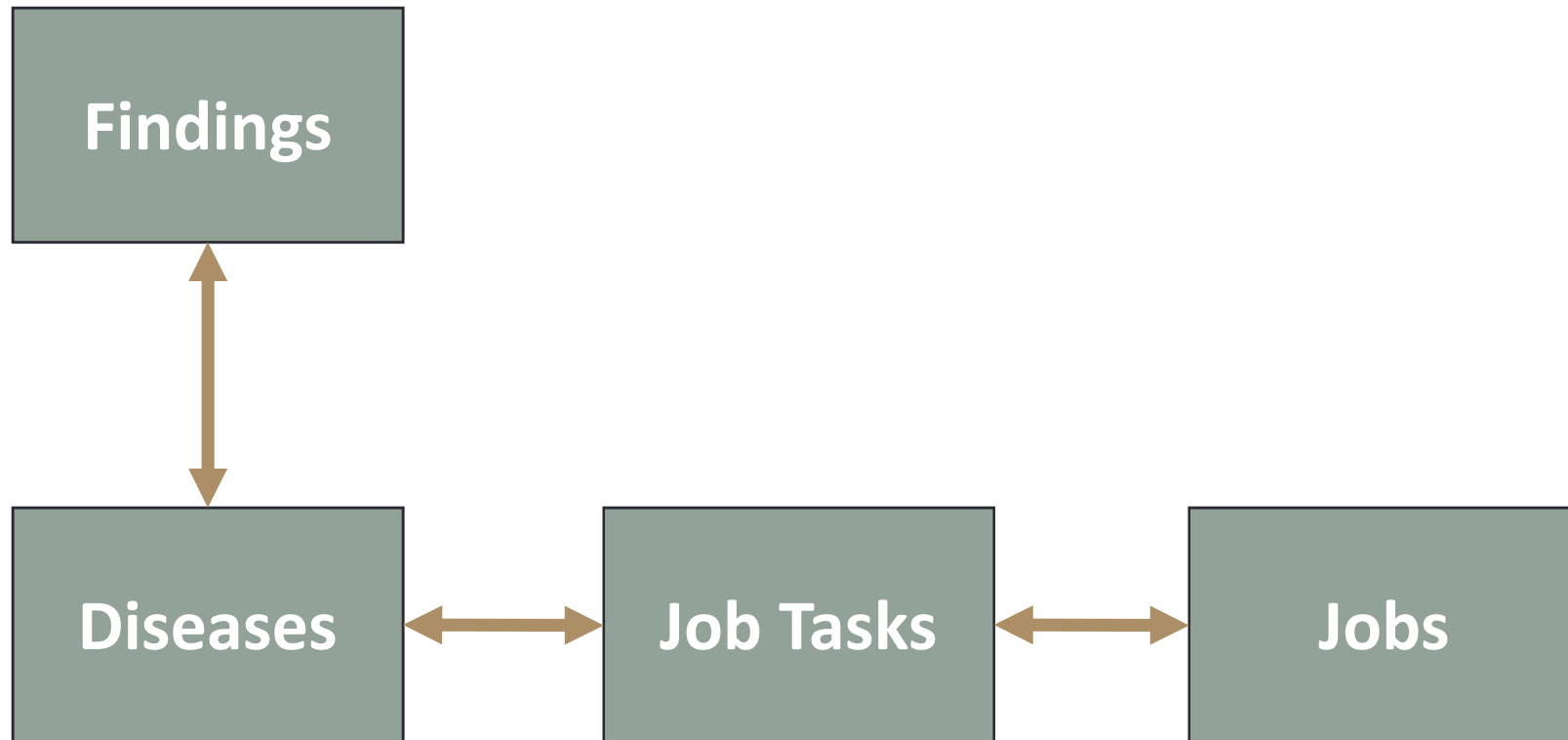
Knowledge Mapping

- Begins with the big picture;
- Helps one not to get lost in the details;
- Keeps all information in context of the whole;
- Distills the facts from the vast sea of data;
- Most useful in information-intensive specialties;

Categories of Findings

Prefix	Finding Category	Prefix	Finding Category
>	General	O	Ophthalmologic
C	Cardiovascular	R	Respiratory
E	Ears, Nose & Throat	S	Skin
G	Gastrointestinal	U	Genitourinary
H	Hematologic	X	Chest X-ray
M	Musculoskeletal	*	Complication

Four Major Tables in the Database



Each Table Contains Records

- 249 Diseases
- 99 Findings
- 63 Job Tasks
- 94 Jobs

Which Diseases Are Covered?

- The 249 diseases are very similar to those covered in the latest edition of *Control of Communicable Diseases Manual* (CCDM).
- Each disease is linked to high-risk job tasks (63), signs & symptoms (99), epidemiological factors (39), endemic regions of the world (16), and incubation periods (7).
- The main categories of diseases are arthropod-borne, childhood, person-to-person, foodborne, gastroenteritis, localized infections, sapronoses, sexually-transmitted, and zoonoses.

High-Risk Job Tasks and Prevention

- Identify high risk groups.
- What are the specific job tasks that put workers at risk for the disease?
- Each hazardous job task links to one or more disease and one or more jobs.

Examples of Hazardous Job Tasks

- Handle infected rodents (bite);
- Handle infected rodents (not bite);
- Handle dog or cat (bite or scratch);
- Have dog or cat contact (fecal-oral);
- Handle needles or surgical instruments;
- Care for patients (fecal-oral pathogens);
- Work in a medical or research lab;
- Live together in close quarters;

Examples of Hazardous Job Tasks

- Plow or excavate soil in endemic area;
- Raise dust of excreta from rodents;
- Travel to endemic area;
- Work in building infested with fleas;
- Work or play in tick-infested area;
- For a summary of how jobs relate to infectious diseases through job tasks, see these two pages on the Haz-Map website: [Occupational Infections](#) and [Skin Infections](#).

For More Information

- See "Using a Relational Database to Index Infectious Disease Information" published in 2010 in the *Int. J. Environ. Res. Public Health*. The full-text article is available at: www.mdpi.com/1660-4601/7/5/2177/.
- See the IDdx website at www.iddx.com.