



# Automating Medical Diagnostics

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# Medical Diagnosis Today

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- ✿ Informed by:
  - ✿ Patients' medical histories
  - ✿ Symptoms (patients not great at communicating this)
  - ✿ Advertising
  - ✿ Doctor's knowledge
- ✿ Ask 3 doctors to look at the same problem, may get 3 different diagnoses and 3 different treatment plans

# Diagnostic Error: Colorectal Cancer Examples

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- ✿ Missed: Cancer missed at 3 different primary care visits despite alarming symptoms
- ✿ Inappropriately delayed: Patient had an abnormal laboratory test result (e.g. iron deficiency anemia) but no one reviewed the results or notified the patient
- ✿ Wrong: Patient told they have hemorrhoids at these visits but actually have cancer

# Effects of Diagnostic Errors

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- ✿ “Most people will experience at least one diagnostic error in their lifetime, sometimes with devastating consequences.” - Institute of Medicine (2015)
  - ✿ Prevent or delay appropriate treatment
  - ✿ Result in psychological or financial repercussions
  - ✿ Lead to unnecessary or harmful treatment
  - ✿ Death:
    - ✿ Diagnostic errors contribute to approximately 10 percent of patient deaths (Institute of Medicine (2015))
    - ✿ Johns Hopkins study (2012): 40,500 patients die each year in US ICUs due to misdiagnosis (~ number of deaths from breast cancer per year in the US)



# Effects of Diagnostic Errors

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- ❖ Add to rising healthcare expenditures:
  - ❖ The leading type of paid medical malpractice claims  
(Institute of Medicine (2015))
  - ❖ Represent the highest proportion of total payments  
(Institute of Medicine (2015))



# Medical Data

IMS (FOR, Endocrinology) (Patient: DABBS, Jorge)

Action View Setup Activities Billing Reports Utilities Workflows

Visit Note (Dec 21, 2011 1 of 1) (Supervising: DABBS, Jorge)

Male 66 y

General Allergy Current Medication Reason for Visit HPI Medical History Surgical History Social History Family History Immunization ROS Vital Signs Examination Procedures Thyroid Ultrasound Review Diagnostic/ Diagnosis Prescription Assessment/Plan Diagnostic/Lab Office Test Careplan (Handouts)

Patient: Dabbs, Jorge Gender: Male Address: Street 6: Insurance: BC OF

Reason for Visit: Mr. DABBS, a 66 ye

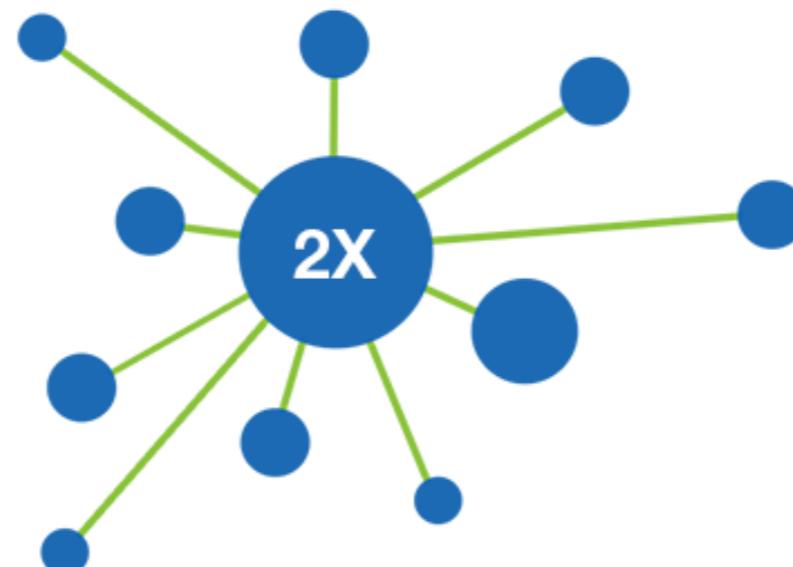
HPI: He has type 2 diabetes. He is currently using multiple daily insulin injections. He forgot to bring his insulin pump monitoring system. He takes rapid acting insulin for every 5 points above a blood sugar target or 5.

Thyroid Biopsy Consent

Ready system Ver: 12.0.5.0331

start INS (FOR, Endocrin... Screen Shots

A screenshot of a medical software interface for Endocrinology. The main window shows a visit note for patient DABBS, Jorge, a 66-year-old male. The note details his general information, reason for visit (type 2 diabetes), and HPI (multiple daily insulin injections). It also mentions he forgot his insulin pump monitoring system. The interface includes a sidebar with various medical history and test categories, and a bottom section for consent forms like 'Thyroid Biopsy Consent'.



## The Data Explosion

Medical data is expected to double every 73 days by 2020.

<https://www.ibm.com/watson/health/>



# Automating Medical Diagnostics: Machine Learning Methods Used

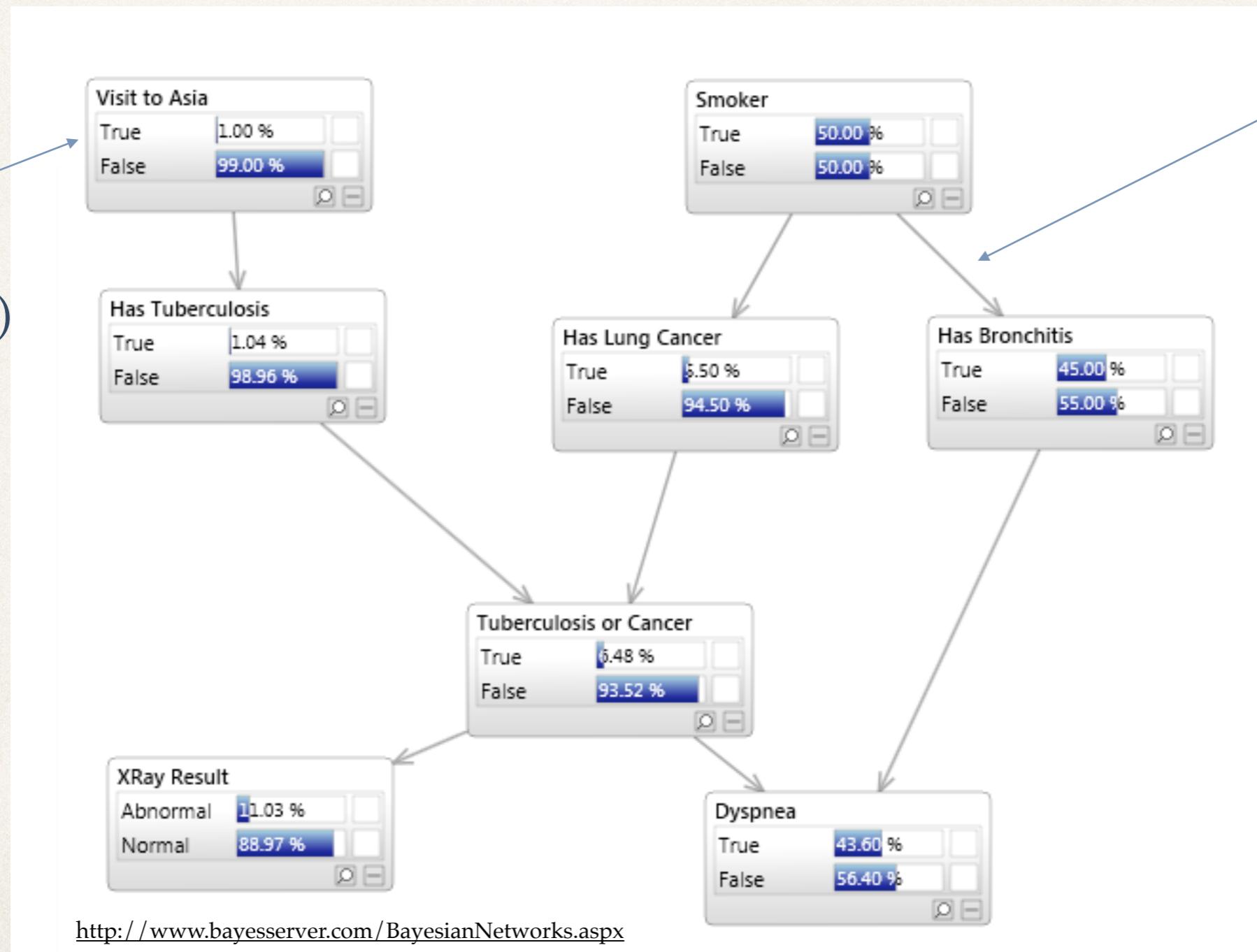
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- ✿ Bayesian networks
- ✿ Decision trees
- ✿ Random forest
- ✿ Neural networks
- ✿ Support vector machines
- ✿ More...



# Bayesian Network: Example - Asia Network

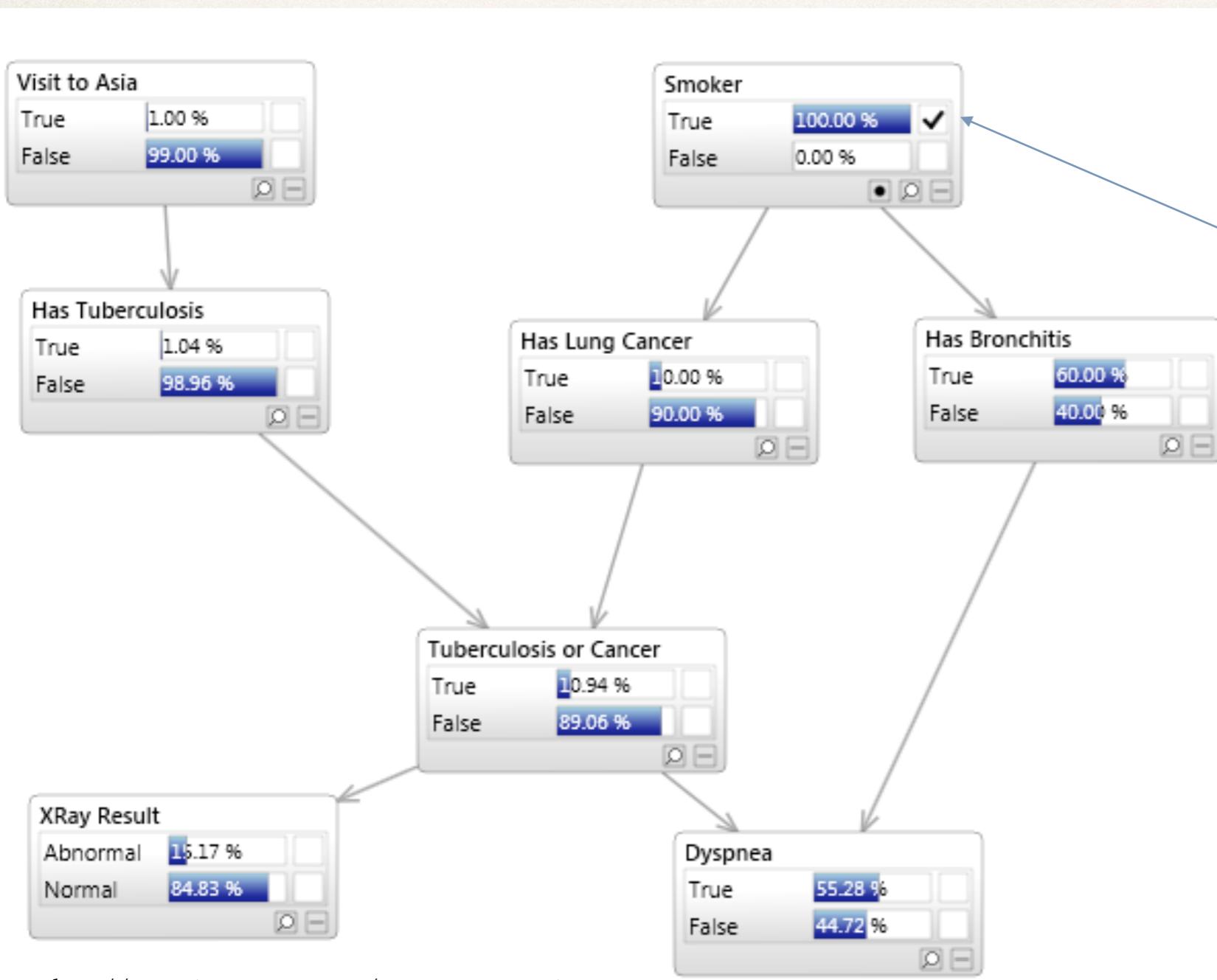
Nodes  
represent  
variables  
(discrete or  
continuous)



Arcs represent  
direct  
connections  
between the  
variables.

# Bayesian Network:

## Example - Asia Network



Variables updated automatically as new information becomes available

Common structure for diagnostic networks:

- 1) Predisposition nodes at the top which influence the likelihood of the disease(s)
- 2) Condition/disease nodes in the row below
- 3) Symptoms/observables at the bottom

# Bayesian Network: Example - Asia Network

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| <b>Has Bronchitis</b> | <b>Tuberculosis or Cancer</b> | <b>Dyspnea = True</b> | <b>Dyspnea = False</b> |
|-----------------------|-------------------------------|-----------------------|------------------------|
| True                  | True                          | 0.9                   | 0.1                    |
| True                  | False                         | 0.8                   | 0.2                    |
| False                 | True                          | 0.7                   | 0.3                    |
| False                 | False                         | 0.1                   | 0.9                    |

# As you might imagine...

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Machine learning algorithms can also be used to  
automate treatment plans as well!

# Companies Focused on Using Machine Learning to Automate Medical Diagnostics

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DeepMind Health

## Medical Research

We think that machine learning technology, a type of artificial intelligence, can bring huge benefits to medical research. By using this technology to analyse medical data, we want to find ways to improve how illnesses are diagnosed and treated. Our goal is to help clinicians to give faster, better treatment to their patients and all our research work is done in collaboration with doctors and professional healthcare

[Read More](#)

**We apply machine learning to medicine to help doctors save lives**

**We draw insights from billions of clinical cases to improve every medical decision**

**We start with diagnosis, where every patient's journey begins**



# IBM Watson

- ❖ Capable of storing far more medical information than humans (doctors)
- ❖ Decisions evidence-based, free of biases
- ❖ Employs natural language processing
- ❖ Provides oncologists with individualized oncology treatment options for patients (draws from 290 medical journals, over 200 textbooks, and 12 million pages of text)



<https://www.ibm.com/watson/health/>

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