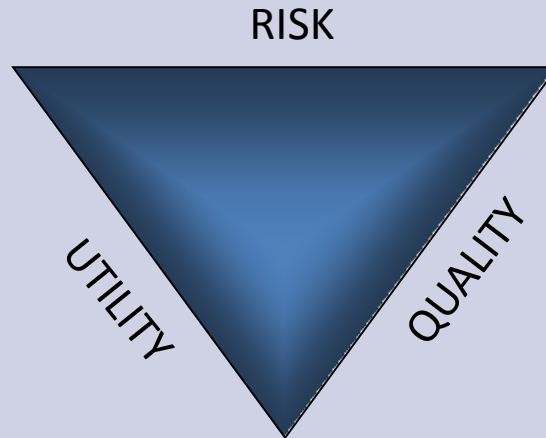



**THE INTEGRATION OF SYSTEMS AND COGNITIVE PROCESSES**



**Mark Gusack, M.D.**

**President**

 **MANX Enterprises, Ltd.**®

DIAGNOSTIC ERROR IN MEDICINE CONFERENCE

6 NOV 2016

© 2016

## SPECIAL THANKS TO

Mark Graber, M.D.

Laura Zwann, PhD.

Robert El-Kareh, M.D.

Janice Kwan, M.D.

For allowing this time with you 'hear' today.

## ACKNOWLEDGEMENTS

William S. Yamamoto, M.D. as mentor and inspiration in medical informatics and artificial intelligence

Barry W. Walcott, COL MC, RET as mentor and teacher in medical systems and heuristics

AND THERE ARE MANY OTHERS I OWE MY STATE OF KNOWLEDGE



# WHO AM I?

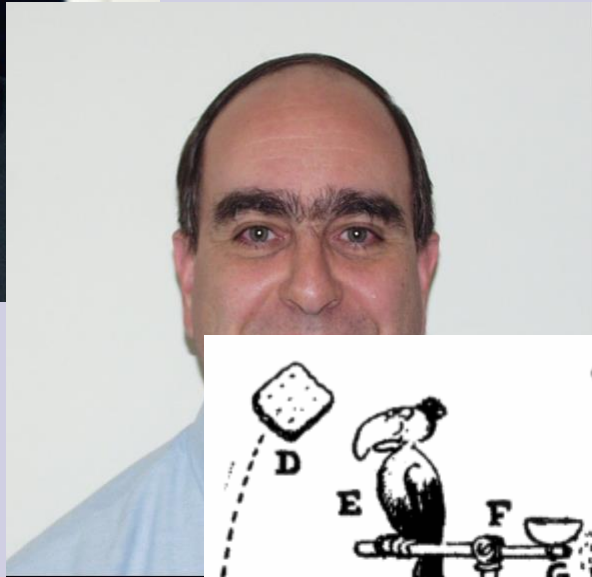
THIS IS HOW I SEE  
MYSELF!

# WHO AM I?

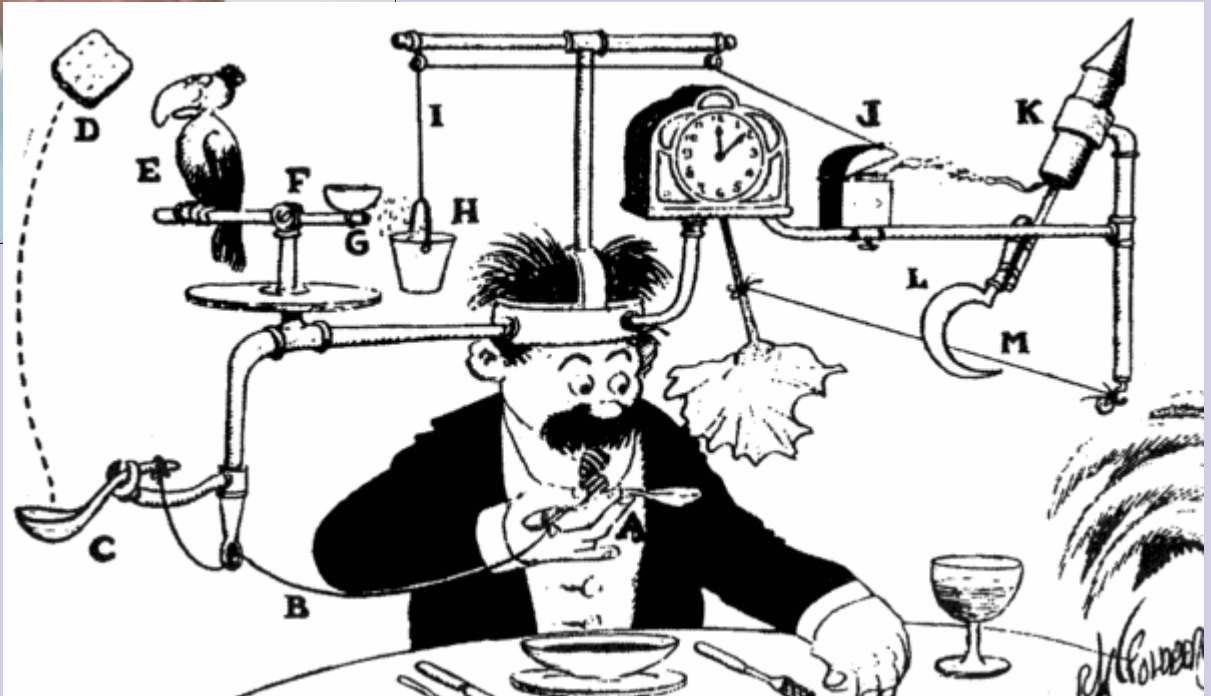


THIS HOW I USED TO  
LOOK...

# WHO AM I?



AFTER READING THE PRESENTATION, THIS IS HOW YOU WILL SEE ME...





# PRESENTER

Mark Gusack, M.D., OCD [Overly Concerned Doctor]

Pathologist

Informationalist

Integrated Systems Manager

**MANX** Enterprises, Ltd.

304 521-1980

[www.manxenterprises.com](http://www.manxenterprises.com)

[mark@manxenterprises.com](mailto:mark@manxenterprises.com)

## AVAILABLE TO CONSULT TO YOUR NEEDS

Dr. Gusack has over 45 years experience in the Laboratory field starting as a Nuclear Medicine Technologist in the early 1970's, then working as a clinical engineer, and then becoming a physician and pathologist. He is AP/CP boarded, has held positions in a variety of hospital and reference based laboratories as a medical director and as staff pathologist. During this time he has also been a consultant and practiced as a Licensed Health Care Risk Manager in Florida. Dr. Gusack has been involved with all aspects of laboratory development and management including startup, licensing, as well as designing integrated management systems for clinical laboratories.

**The opinions expressed in this presentation are those of the author and do not necessarily represent those of anyone else on Earth**

## SITUATION PART I

*“...the vast scale of political, economic, social, and technological change confronting modern organizations is placing unprecedented information-processing burdens on the individuals and groups working within them.”\**

\*Hodgkinson, GP Healey, MP **Cognition in Organizations**; The Annual Review of Psychology 2008. 59: 387-417.

## SITUATION PART II

- ➔ Accelerating improvements in healthcare have created a paradox of **increased capability** offset by **increased complexity**.
- ➔ This has challenged our **cognitive capabilities** to understand and control the behavior of the **complex systems** we have put into place to deliver healthcare.
- ➔ This has increased **latent** organizational **systems problems** that impact **cognition** during the diagnostic process.
- ➔ **Taxonomy** that **addresses systems and cognition separately** leads to inherent weakness in the creation of knowledge as well as its organization limiting its usefulness.
- ➔ The result; a body of work regarding diagnostic error **lacking a unified architecture** that hinders the **Reduction of Diagnostic Error in Medicine**.
- ➔ And this has led to the increased **Perception of error** on the part of the patient and of a society whose expectations have grown with the rise of modern medicine.

As the recent Institute of Medicine [IOM] report of September 2015 Improving Diagnosis in Health Care notes, the present approach to managing this complexity to reduce error has not been successful.

**HOW DO WE GAIN CONTROL OVER THIS COMPLEXITY?**



## BUT BEFORE WE GO FURTHER THERE'S THE BUG-A-BOO OF **PRECISION MEDICINE**

Today there is a lot of talk about “**Precision Medicine.**” However, articles attempting to define what this means fail miserably.

In a recent Perspective article in the New England Journal of Medicine David Hunter quotes a recent National Academies Press work by the Committee on **A Framework for Developing a New Taxonomy of Disease** and notes that the term Precision is used:

**“...in a colloquial sense to mean both ‘accurate’ and ‘precise’”**

he notes this **implies a high degree of certainty** and then shows this is **just the opposite of the truth** which is that it leads to ***greater uncertainty.***

The Early Bird Poster Illustrates this problem when highly sensitive screening modalities are employed

**WE NEED TO DO BETTER THAN THIS**

## SO, HOW DO WE PROCEED?

BEFORE WE CAN SOLVE THE PROBLEM OF DIAGNOSTIC ERROR WE NEED TO AGREE ON:

**TERMINOLOGY** DEFINITIONS OF MEANING OF WORDS DESCRIBING DIAGNOSTIC ERROR

**TAXONOMY** ORGANIZE OUR KNOWLEDGE ABOUT DIAGNOSTIC ERROR EFFECTIVELY

*“Careful and correct use of language is a powerful aid to straight thinking, for putting into words precisely what we mean necessitates getting our own minds quite clear on what we mean.”*

WILLIAM IAN BEARDMORE BEVERIDGE

# I HUMBLY PROPOSE SOME TERMINOLOGY

## DIAGNOSIS

Classification based on specified clinical criteria

A classification founded upon a set of observable **patient characteristics** that describe at least one **pathophysiologic state** associated with a single **underlying cause**.

## DIAGNOSTIC CRITERIA

Observable patient characteristics used in classifying a patient's state of health

A set of generally agreed upon metrics that define a **Medical Decision Point** based on observable patient characteristics that describe a single diagnosis.

## DIAGNOSTIC PROCESS

Seeking a set of patient characteristics that reliably classify this state

A methodology **founded upon** inductively established relationships between **prior observations** that provide a means for **applying** deductive and abductive logic **to a set of future patient centric observations** leading to a **reliable classification of their clinical state** as the outcome of at least one **pathophysiologic state** and at least one **underlying cause**. [There may be many diagnoses]

## DIAGNOSTIC ERROR

Inaccurate/imprecise observation or erroneous decision making ⇔ DX error

*Inaccurate/imprecise observation* of patient **clinical state** and/or *decision* as to **pathophysiologic state(s)** and/or **underlying cause(s)** for correctly observed patient clinical state(s).

## DIAGNOSTIC FAILURE

Error leading to an unacceptable patient outcome

Diagnostic error that leads to an **unacceptable** state of patient safety, quality of life, cost.

**Unacceptable** to whom?

**WE CAN ARGUE OVER THESE DEFINITIONS BUT AT LEAST THEY FORM A BASIS FOR THIS**

# I PROPOSE SOME MORE DEFINITIONS

## DIAGNOSTIC ACCURACY: [Another way to define diagnostic error]

Of all the most likely diagnoses – based on our observations of the patient’s clinical state – the correct one is chosen to a degree *acceptable* to the:

- ➔ Patient
- ➔ Clinicians
- ➔ Society [Oversight Institutions/Regulatory Agencies ]

## DIAGNOSTIC PRECISION:

Given an accurate diagnosis, characterization of that particular instance in a single patient regarding subtype, severity, extent, prognosis, stage, etc. is correct to a degree *acceptable* to the:

- ➔ Patient
- ➔ Clinicians
- ➔ Society [Oversight Institutions/Regulatory Agencies ]

## DIAGNOSTIC TIMELINESS:

The time taken to arrive at an accurate and precise diagnosis so as to avoid, prevent, or mitigate:

- ➔ **RISK:** A serious adverse outcome *unacceptable* to the patient/clinicians/society
- ➔ **QUALITY:** Undue Suffering of the patient *unacceptable* to the patient/clinicians/society
- ➔ **UTILITY:** *Unacceptable* cost for the patient/healthcare facility/society

So now we see that we need to define a process by which we establish what is acceptable and what isn’t.

**WE CAN ARGUE OVER THESE TOO!**

## ANOTHER WAY TO LOOK AT WHAT A DIAGNOSIS IS!

### PROBLEM IDENTIFICATION

If we cannot reliably identify patient problems we can never solve them except by accident

### PROBLEM SOLVING

If we cannot reliably solve problems then we cannot help our patients achieve optimal health

### PREDICTING THE FUTURE

The ability to speculate on what might happen based on planned actions allowing us to choose between diagnoses to achieve the best outcomes

Acquisition of knowledge based upon factual information allows for a number of very beneficial capabilities that leads to a reduction in **DIAGNOSTIC ERROR IN MEDICINE**.

Therefore, given the incredible complexity of our field of endeavor:

- ➔ Scientifically
- ➔ Technologically
- ➔ Legally
- ➔ Regulatory

**WE MUST PUT INTO PLACE EFFECTIVE KNOWLEDGE MANAGEMENT ACTIVITIES**

BEFORE WE CAN PROCEED WE NEED TO DEFINE OUR MISSION

# TO CARE FOR OUR PATIENTS

AND OUR GOALS?

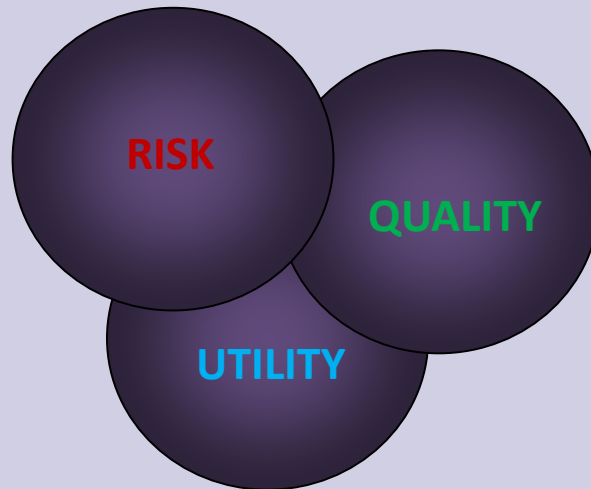
**RISK** *Maximize patient safety* with accurate, precise, and timely diagnoses

**QUALITY** *Minimize pain and suffering* from inaccurate and/or imprecise, and/or delayed diagnoses

**UTILITY** *Minimize expenditure* of scarce resources through cost effective diagnostic processes

HOW DO WE APPROACH THESE?

THESE THREE FULLY DEFINE  
ANY ACTIVITY WE PURSUE  
AND PROVIDE A MEANS OF  
COMPLETE ASSESSMENT



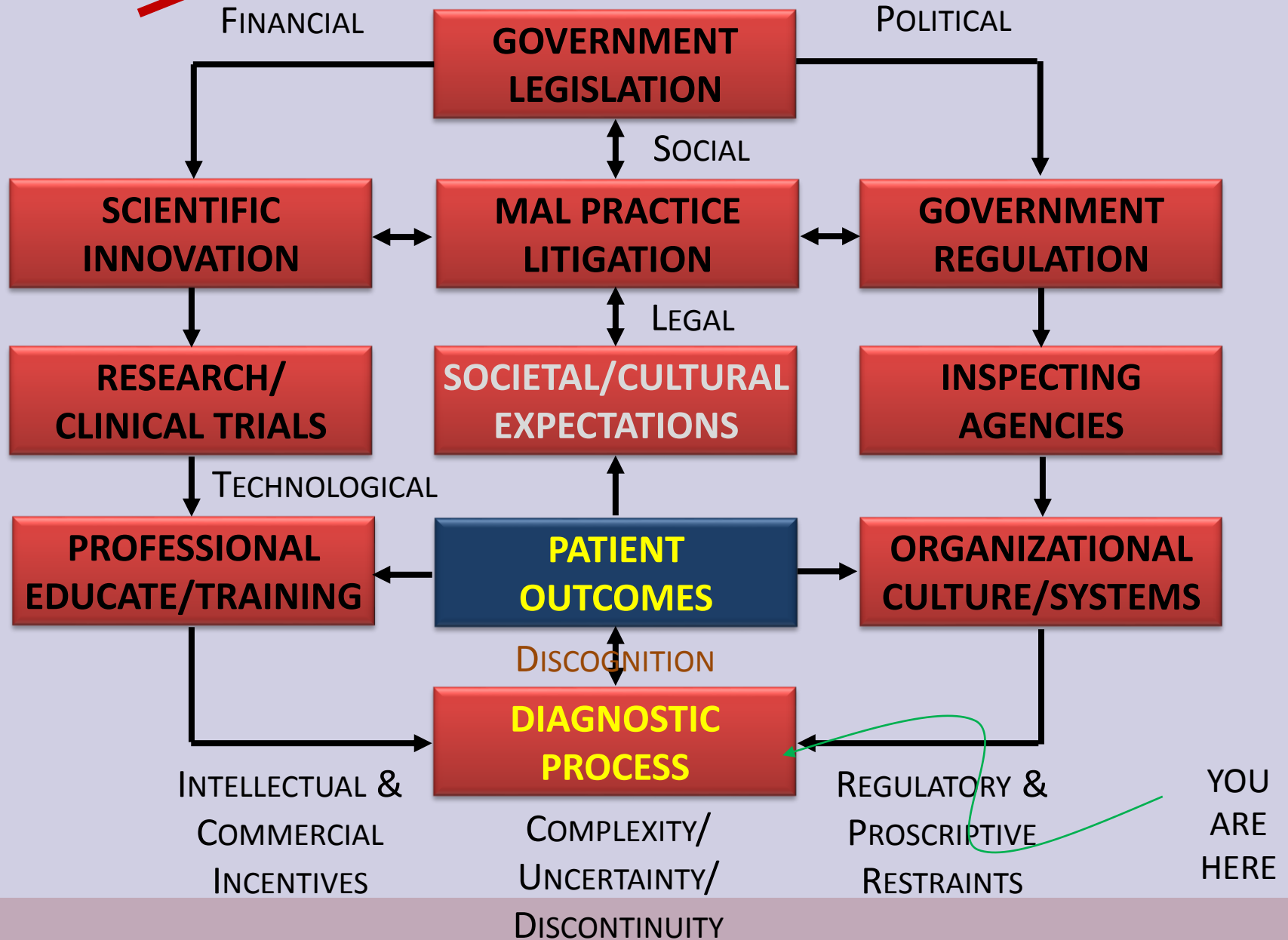
THEY CAN ACT  
SYNERGISTICALLY OR...  
THEY CAN CONFLICT WITH  
EACH OTHER

INTEGRATED SYSTEMS MANAGEMENT

## INTEGRATION OF SYSTEMS AND COGNITIVE PROCESSES

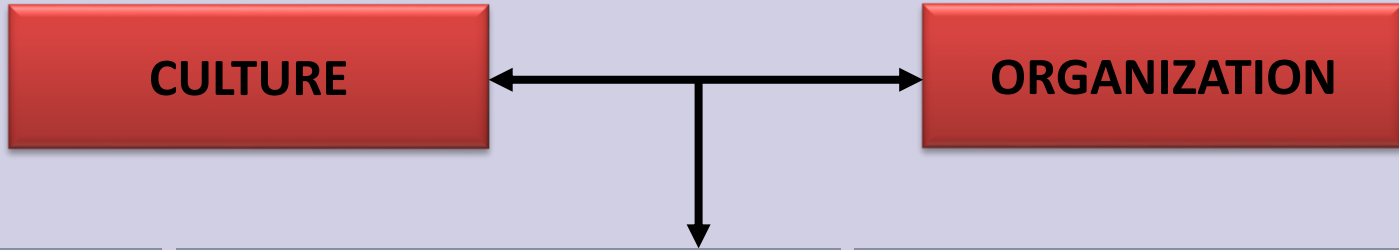
1. Describe how advances in our capacity to diagnose, when combined with more effective therapy has led to greater frequency and significance of diagnostic error.
2. Explain how introducing Failure Mode and Effect Analysis as an organizing imperative allows for integrating systems and cognitive level processes.
3. Discuss how the resulting schema can be used to generate a comprehensive taxonomy for Diagnostic Errors in Medicine.

# SIMPLIFIED SCHEMA OF CULTURAL COMPLEXITY





# MODIFIED FAILURE MODE AND EFFECT ANALYSIS AS A BASIS OF A TAXONOMY



mFMEA	DESCRIPTION	SYSTEMS & COGNITIVE COMPONENTS
SYSTEM [Logic]	Input - <b>Signals</b> /Work/Info Flow/ Branch <b>Logic</b> /Output - <b>Signals</b>	<b>System Design</b> & Implementation <b>Cognitive Response</b> : Decision/Action
COMPONENTS [Tools]	<b>Physical Environment</b> : Plant, Equipment, Devices, and Supplies	<b>Cognitive</b> basis of Design, Manufacture, Application, and <b>Use of Tools</b>
PROCESSES [Procedures]	Ordered <b>Sets of Tasks</b> Designed to Achieve Specified Outcomes	<b>Processing</b> Signals to Symbols to Information to Knowledge through <b>Cognition</b>
SERVICE [Personnel]	Orientation/Priming/Training/ Education/Experience/Judgment	<b>Competency</b> [do it right] and <b>Proficiency</b> [do it efficiently in a timely manner]

FROM THIS WE CAN DEFINE A SET OF GOALS TO REDUCE DIAGNOSTIC ERROR

# WE'LL FOCUS ON RISK GOALS FOR REDUCING DIAGNOSTIC ERROR

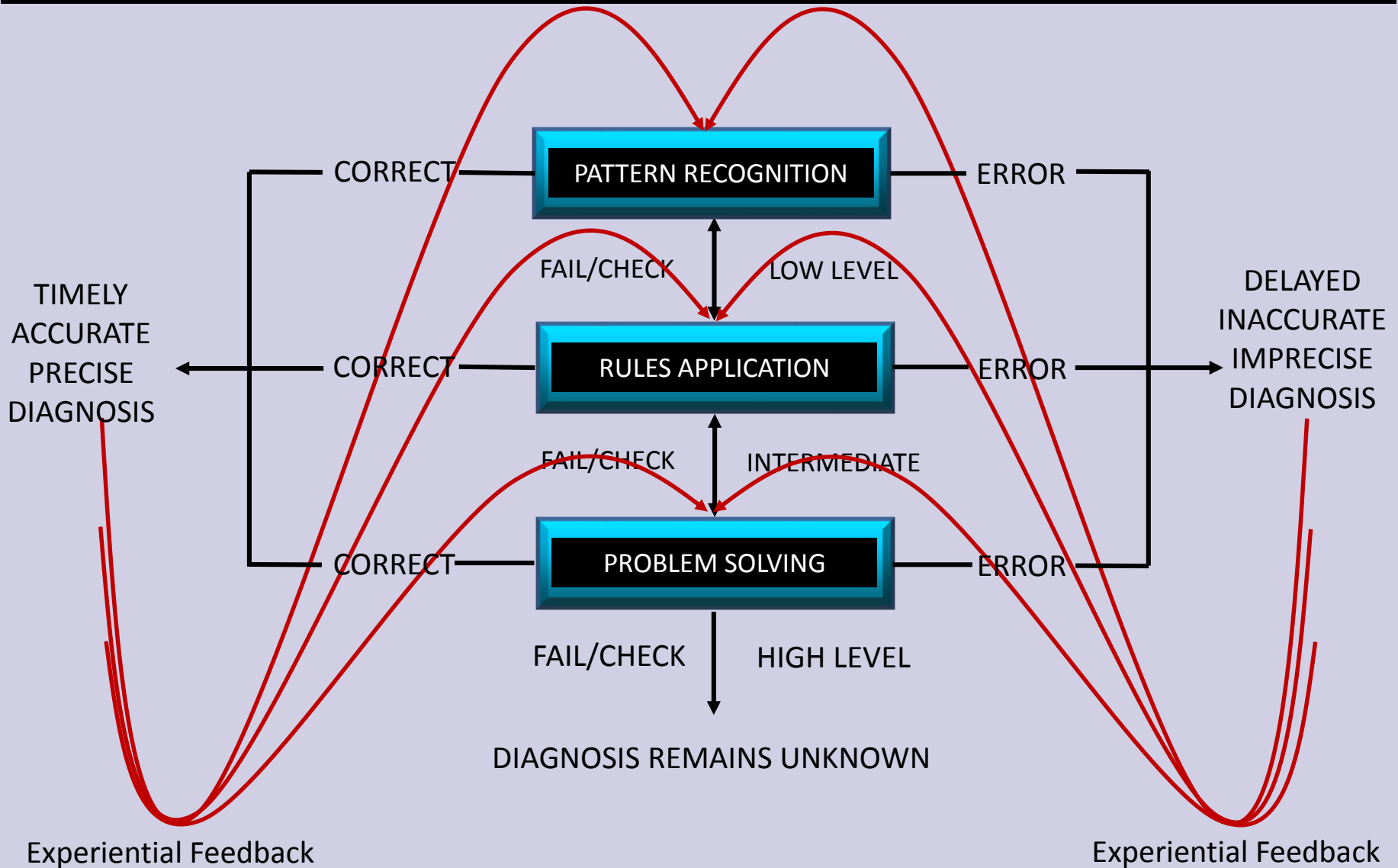
CLASS	TIMELINESS	OBJECTIVES IN REDUCING ERROR
INVESTIGATE Fix	Retrospective	<b>Find Causes of Error/Failure</b> in system and/or cognition; patch them
MITIGATE Intervene	Concurrent	<b>Monitor Tasks</b> to catch and reduce impact of errors we can't prevent
PREVENT Blocking	Prospective	<b>Cognitive Redesign</b> – Change people before they err or replace them
AVOID Don't do it	Prospective	<b>Systems Redesign</b> – Change system before it breaks or replace it

# SERVICE: COGNITIVE PROGRESSION TO DIAGNOSTIC ACUMEN

STAGE	CHARACTERISTIC	DESCRIPTION OF GOALS
ORIENTATION	Enculturation	Imprinting of societal and organizational cultural imperatives
PRIMING	Signal Processing	Developing pattern recognition associated with outcomes
TRAINING	Proficiency	Memorizing, recalling, and applying simple rules - Heuristics
EDUCATION	Knowledge	Learning, recalling, applying associations to solve problems
EXPERIENCE	Competency	Learning from outcomes of decisions and actions – from error
JUDGMENT	Reliability	Learning to make better decisions under uncertain conditions
WISDOM	Insight	Learning to avoid situations where there is no good decision

It should be noted that each step in the process cannot be fully separated and are interrelated so the progression needs to be designed to maximize each of the goals sought through appropriate feedback at each level.

# THE COGNITIVE CASCADE IN THE DIAGNOSTIC PROCESS - ABBREVIATED



**NOTE:** Each step may lead to additional signals causing movement up and down the cascade

## NEED CONSULTING SERVICES?

I have extensive experience and knowledge in the following areas:

- ➔ Laboratory Medicine – 45 years
- ➔ Anatomic Pathology – 38 years
- ➔ Risk Management/Quality Management/Resource Management [ISM] – 35 years
- ➔ Failure Mode and Effect Analysis [FMEA] – 20 years
- ➔ Information Management – 50 years experience including computer programming
- ➔ Document Management – 35 years
- ➔ Knowledge Management – 25 years
- ➔ ISO 15189 Assessments – 1 year (Oh well...have to start somewhere)

**Contact me at**

**MANX Enterprises, Ltd.**

304 521-1980

[www.manxenterprises.com](http://www.manxenterprises.com)

[mark@manxenterprises.com](mailto:mark@manxenterprises.com)

**AVAILABLE TO CONSULT TO YOUR BOTTOM LINE; NOT OUR BOTTOM LINE**

**ALLOW ME TO HELP YOU APPLY INTEGRATED SYSTEMS MANAGEMENT [ISM]**