Journées Francophones d'Imagerie Médicale

Errors in medical imaging

"To err is human"

Robert Lavayssière, M.D.

JFIM Buenos Aires, October 26, 2017

Overview

1. Definition
2. Facts and figures
3. Multiple Cause
4. Legal issues
5. Remedies
6. Conclusion

Error or discrepancy ?

- Diagnosis missed, wrong or delayed, detected by subsequent test or finding (Garland, Radiology, 1949).
- Mistake that has management implications for the patient (RSNA 2007).
- Though errors are common, measuring them is a challenge because definition of truth varies, even among experienced radiologists (Brigham L, AJR 2015).
- Most errors do not result in significant harm…

(Wu AW, J Gen Intern Med, 1997).

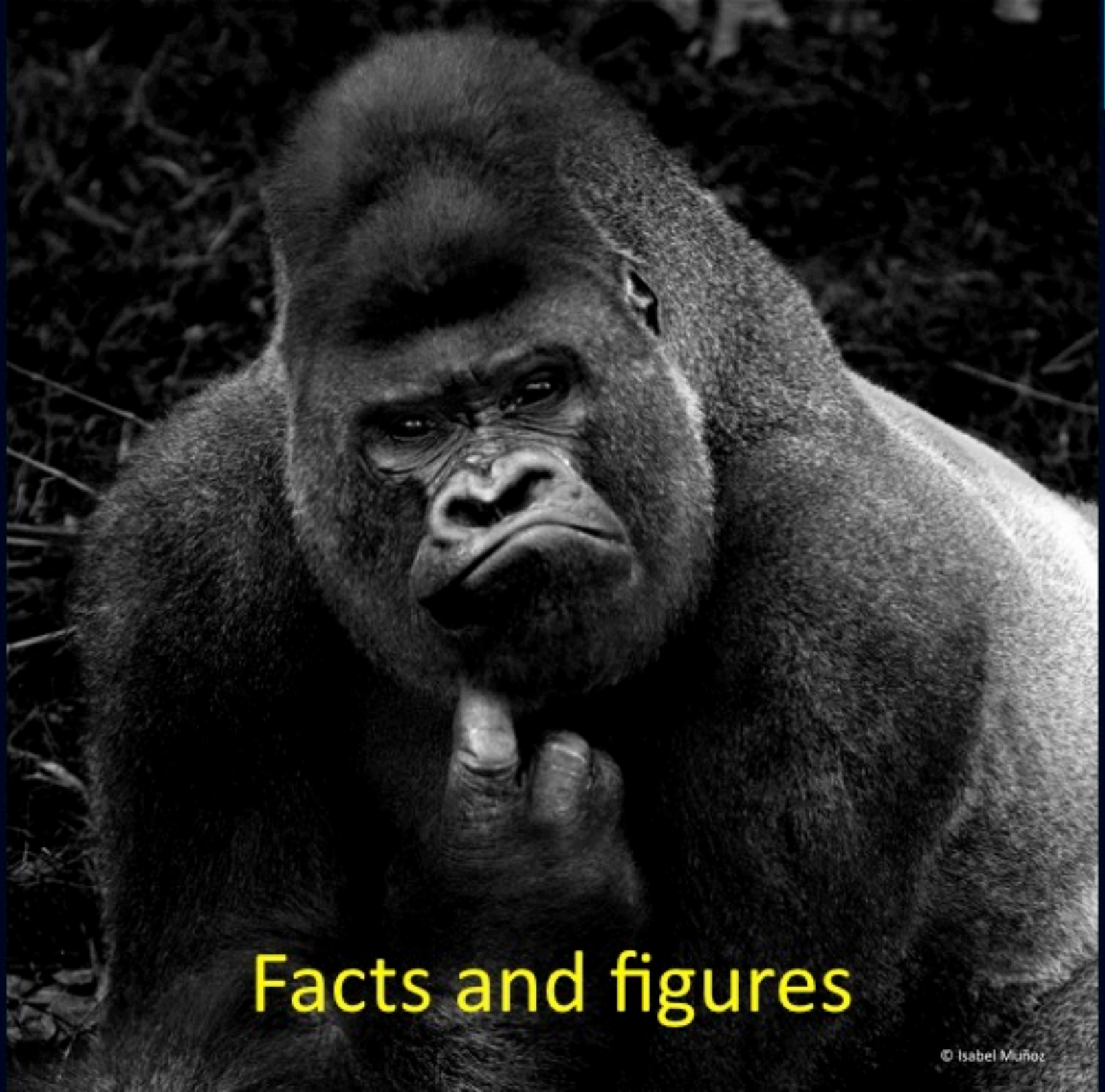
Radiological vs clinical errors

- **Images are preserved for ever**

Many errors that go unnoticed in clinical medicine are readily identified in radiology because images are preserved for ever, and can be reviewed after the fact (Berlin L, National Academy of Sciences, Washington 2014).

- **Written interpretations**

Written interpretations by radiologists of radiologic studies are extremely important from both medical and legal perspectives (Berlin L, AJR 2000).


Facts and figures
© Isabel Muñoz

Facts and figures…

- 44 000 to 98 000 people die each year in USA from inpatient medical errors (Institute of Medicine, 1999).
- Real time error rate in day to day practice: 3 to 5 % (Sistrom, Borgstede) !
- CXRs of suspected tuberculosis cases: inter-observer discrepancy up to 20 %.
- 19 % of lung Ca missed on previous X Rays (up to 73 %!)
- Emergency Dpt: estimated incidence between 3 and 6 %
- Discrepancy between neuroradiologist and primary general radiologist: up to 13%.
- Clinical diagnoses vs post-mortem: major diagnosis missed clinically in 26 % of cases (Mayo Clinic 2000)

Discrepancy…

Discrepancy rates among radiologists' interpretations of Abdominal and Pelvic CTs

Re-reading of 60 cases by 3 experienced radiologists

Inter-observer 26 %

Intra-observer 32 %

Hani H. Abujudeh & al, Eur Rad 2010

Cause (s)

Two main types

- Individual or “active errors”: perceptive/ cognitive (interpretive).
- System related or “latent errors”

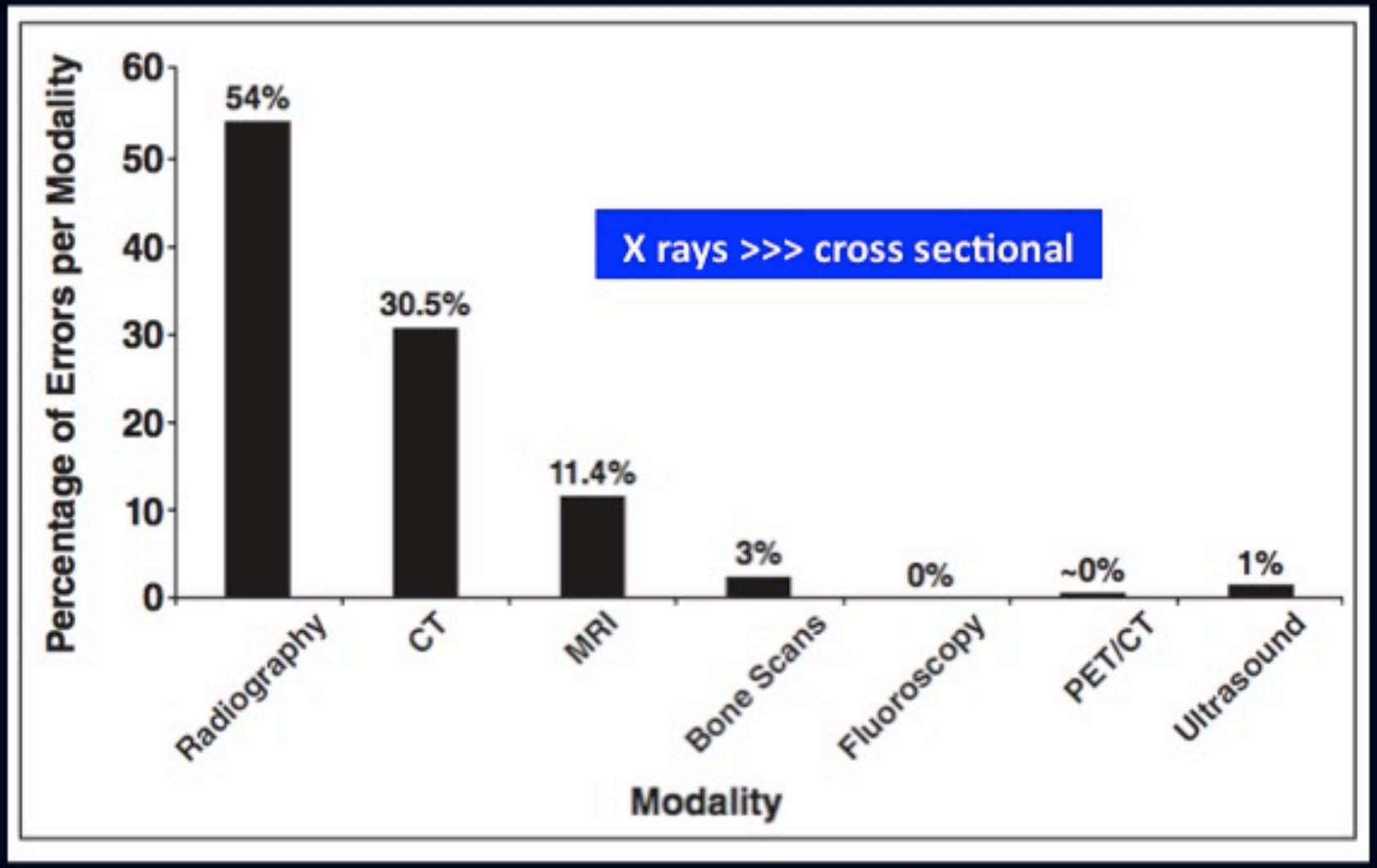
Interpretation is a dual process, type 1 “automatic” and type 2 “analytic and effortful” with oscillations between the two.

Classification of rads'errors

	Cause		%
1	Complacency	Error mix: over reading, misinterpretation: false positive	0.9
2	Faulty reasoning	Abnormal finding attributed to a wrong cause. Misleading	9.0
3	Lack of knowledge	…	3.0
4	Under reading	Finding is missed	42.0
5	Poor communication	Report is correct but message fails to reach the clinician	NA
6	Technique	Limitations of examination or technique	2.0
7	Prior examination	Failure to consult prior examinations/alliterative bias	5.0
8	History	Inaccurate clinical history/framing bias	2.0
9	Location	Lesion missed because outside the area of interest	7.0
10	Satisfaction of search	Other finding (s) missed: failure to continue to search	22.0
11	Complication	Procedure	0.5
12	Report	Overreliance of the radiology report of previous exam.	6.0

Adapted from Bruno, Kim, Renfrew, Smith

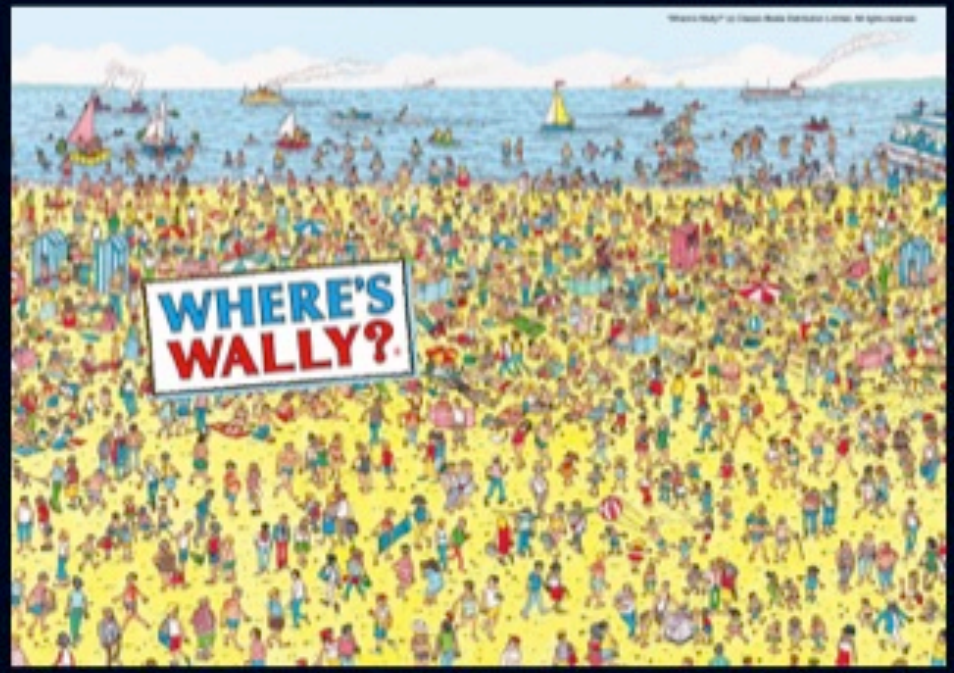
Is a modality more prone to error ?



Kim et al. AJR 2014

Under reading: n°1

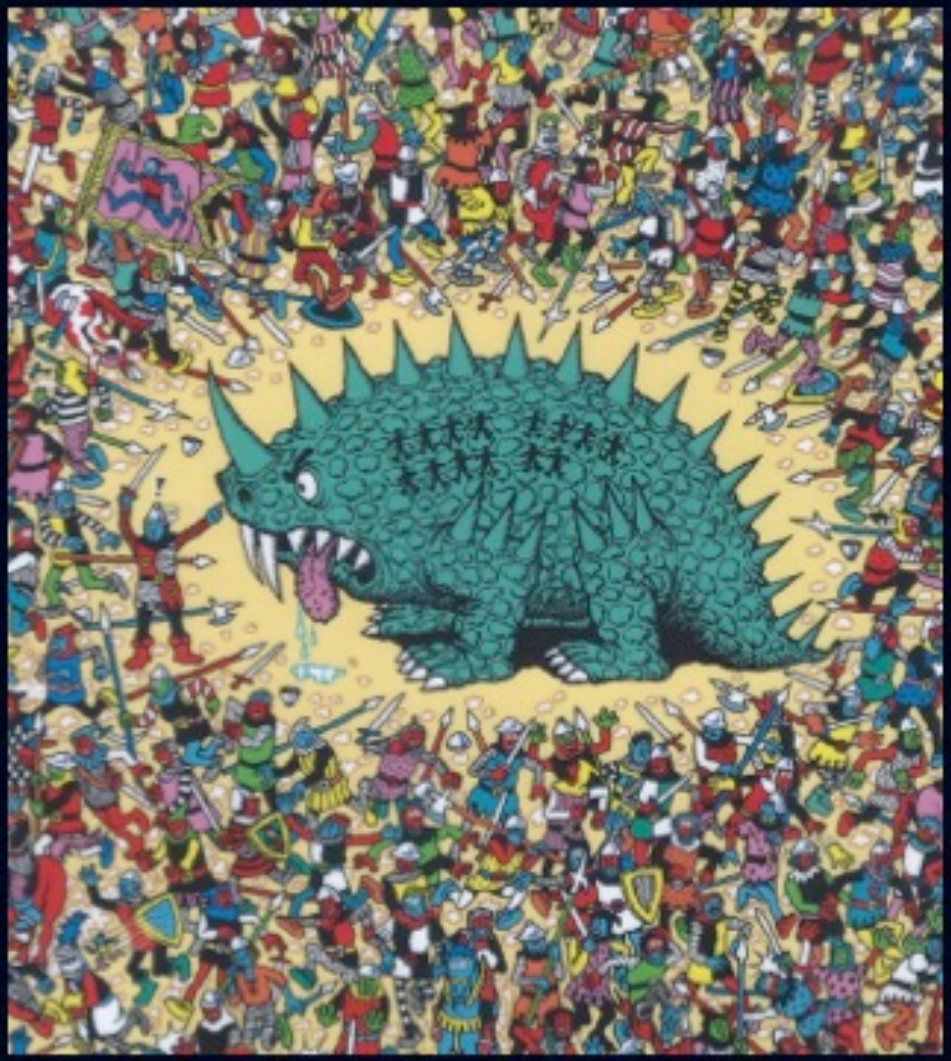
- Complexity: psychologic, physiologic, cognitive processes.
- Visual search pattern: habit, practice, clinical knowledge, disease pattern, type of abnormality, dwelling time…
- Central and peripheral vision!
- Mostly unexplained: level of conscious awareness, short term memory, biases…
- Not many solutions: image treatment and CAD, check list, structured or semi-structured report !!!



Influenced by

- Visual fatigue
- Decision/mental fatigue (shortcuts)

Satisfaction of search: n°2



- Tendency to stop a search for abnormality once one diagnosis is likely.
- MSK +++/Breast Imaging
- Associations...
-  Need for a secondary reading: read twice (at least)!!!

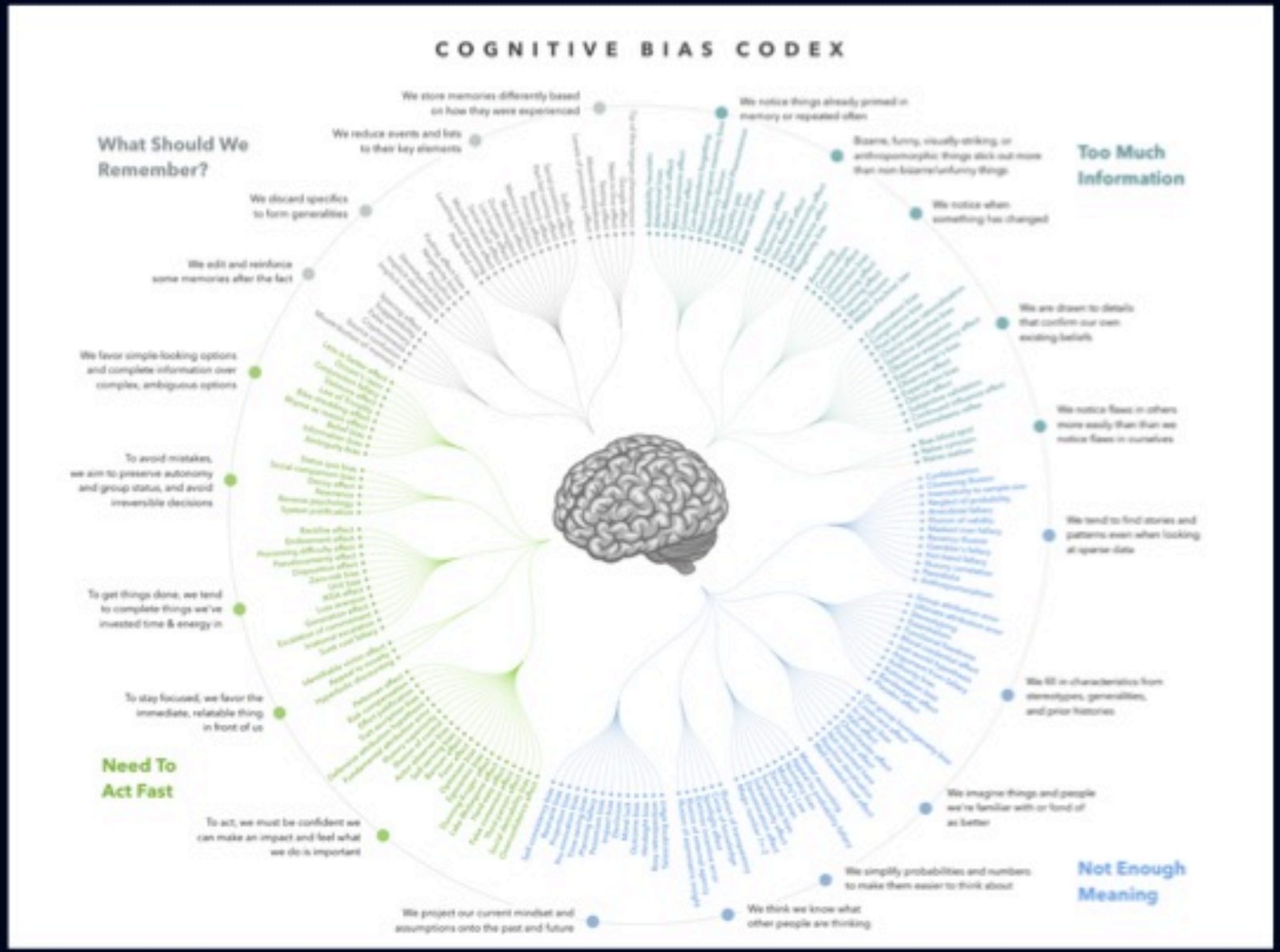
Gorilla in the mist

The invisible gorilla strikes again: sustained inattentional blindness in expert observers

- 24 radiologists: lung nodule detection
- Gorilla 48 times larger than the average nodule inserted in the last case
- 83 % of the radiologist did not see the gorilla even if they looked at it (eye tracking) with sufficient a dwelling time
- Mixed origins: satisfaction of search (nodules) and unexpected stimulus (ie gorilla)

Drew T Psychol Sci 2013

About 75 % of errors come from cognitive biases



Biases (40 !): faulty cognitive processes

- Anchoring bias: initial impression/salient feature leading to discount other information.  Avoid early guess !
- Confirmation bias: look for confirmatory evidence to support or discount an evidence
- Premature closure: accept a diagnosis before full verification (differential diagnosis)
- Availability bias: recent experience with a disease inflating likehood, underdiagnosis of rare disease

Influence of clinical information

- Framing bias:
  - Beware of
    - Partial history
    - Misleading history.
  -  Masked read before reviewing clinical indication!!!
- No clinical detail: under reading…

Influence of previous studies

- Perpetuated or alliterative errors:
  - reading the previous report before reading the exam
  - tendency to agree why peers and trust them
- Non consultation of previous examination resulting in missed findings (Teleradiology without PACS access +++).
-  Consultation and comparison should be mentioned in report and justified (i.e. measurements) !!!

System issues contributing to errors

- Excess workload/reduced time for interpretation
- Staff shortage/inexperienced staff
- Inadequate communication
- Inadequacy of clinical information
- Unavailability of previous studies/ reports for comparison
- Inadequate medication
- Inadequate expectation
- Inadequate equipment
- Data handling/report handling: transcription/speech recognition

Errors in communication

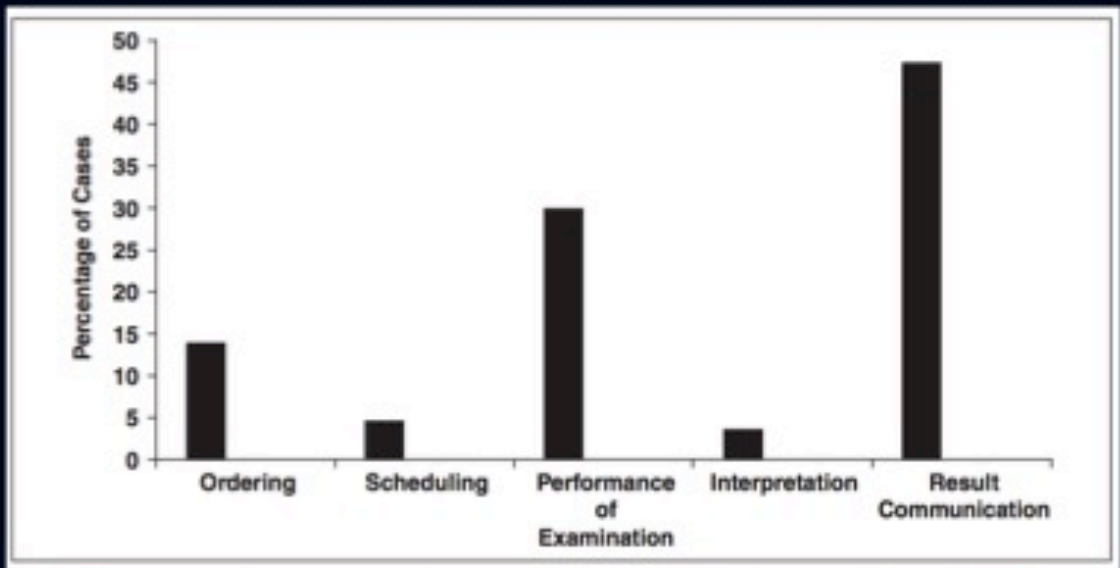


Fig. 1—Percentage of communication errors occurring during different steps in imaging process.

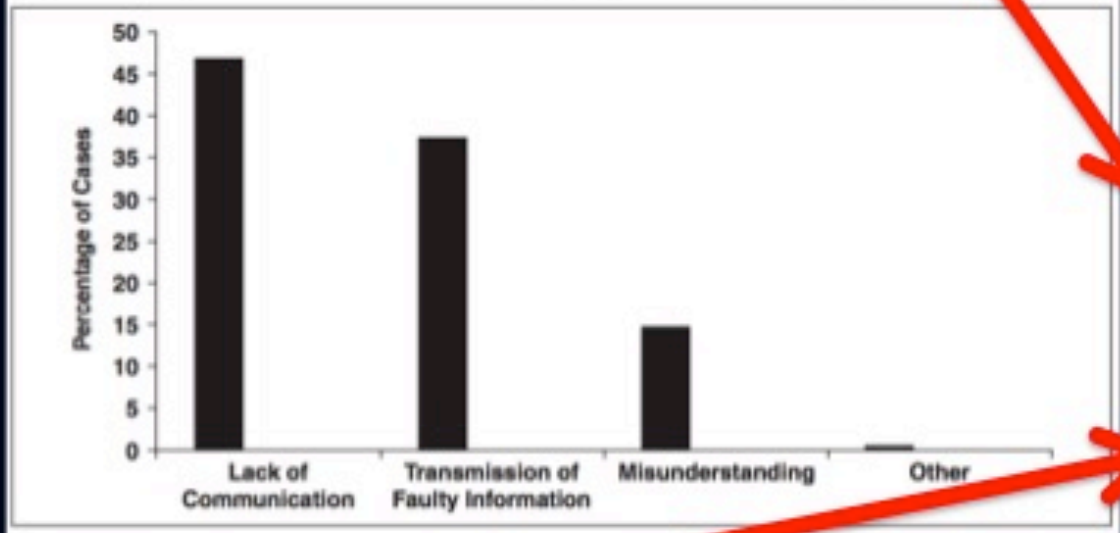


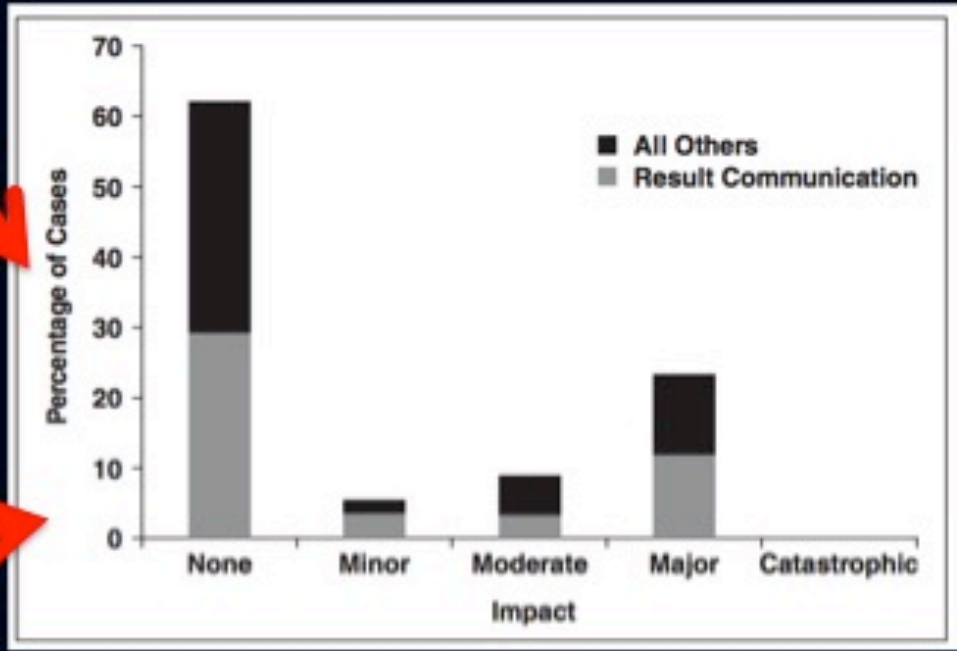
Fig. 2—Percentage of types of communication errors.

380 communications errors over 10y

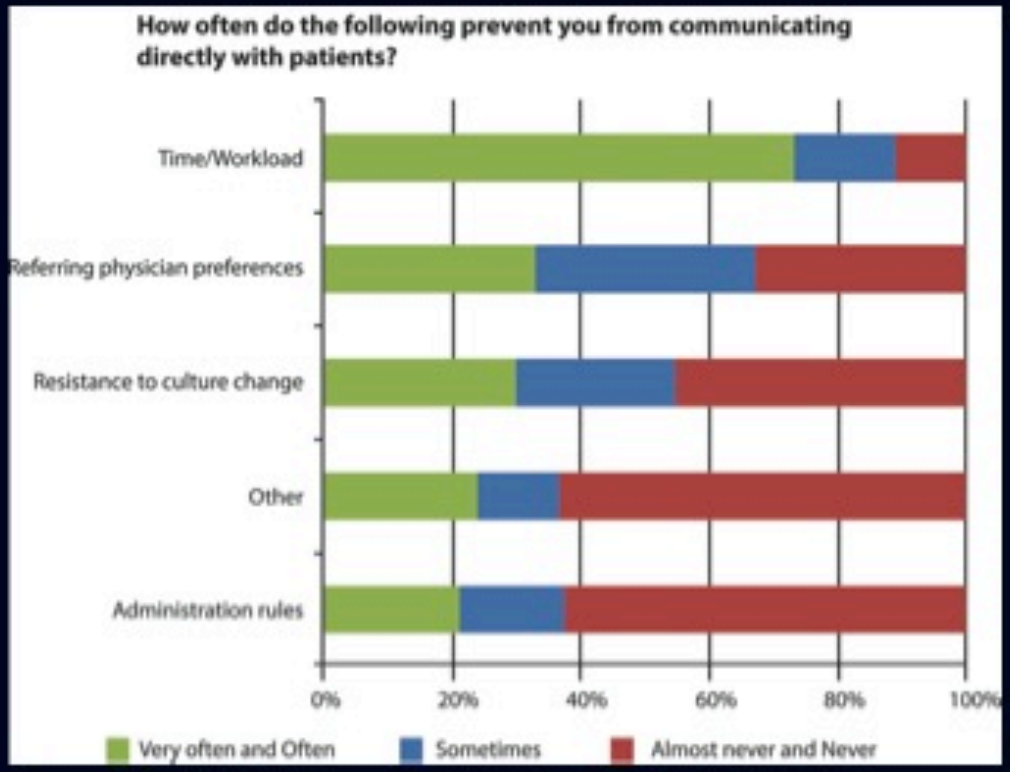
37,9 %: direct impact on patient care
52,6: potential impact

Rule of report for abnormal results !

Siewert B (AJR 2016)



Meeting patients…



Kemp J, Radiology 2017

One of my mistakes…

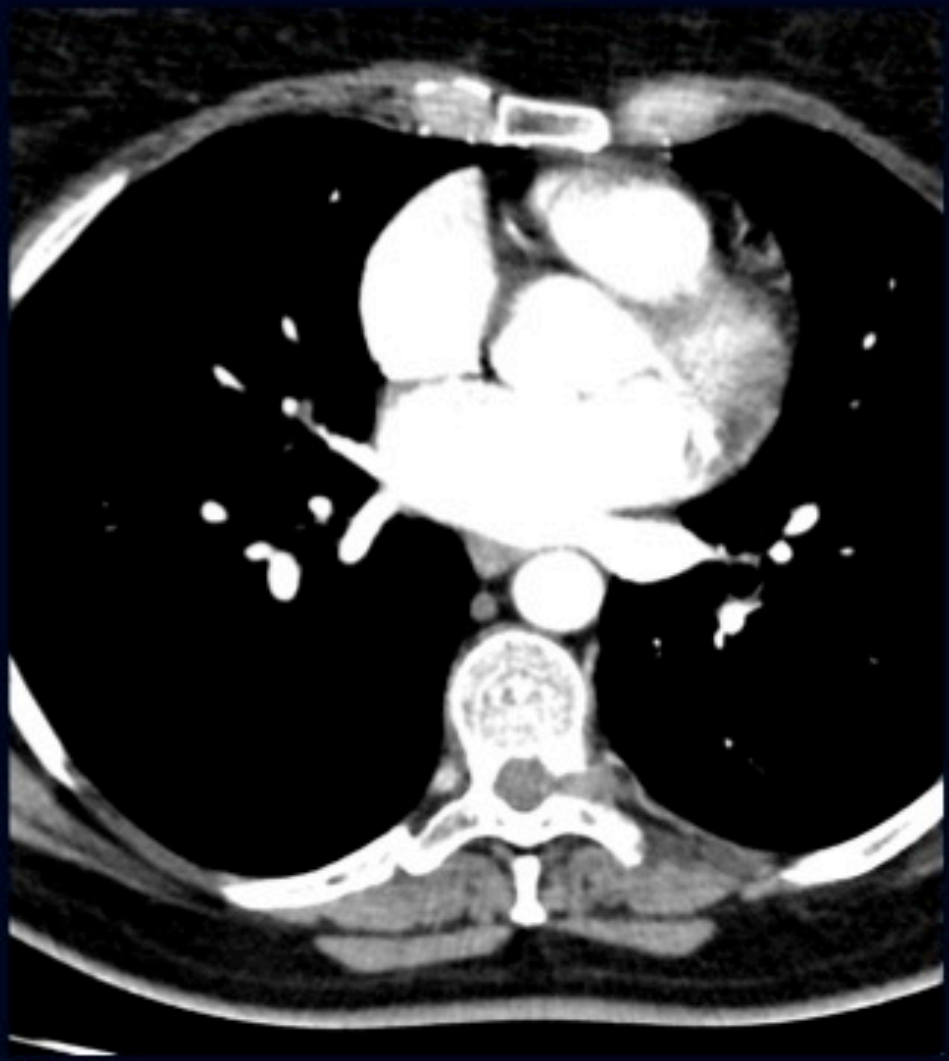
54 YO Female referred for CT of the thorax.

- She is complaining about a middle dorsal pain.
- She is mentioning an increase of pain in the middle of night

CT report: unremarkable findings

MRI is suggested because of clinical symptoms

Ahem…



Poor radiologist but good doctor !

"The" report

Rads are paid to use their eyes and their brain

- Final product: patient and referring physician, judge/ jury…

- Patient details should be accurate (name, age, sex)
- Body/description and conclusion: be concise and precise: avoid vague wording
- Level of language: "average high school graduate". Do not use rare acronyms.
- Use structured (or semi) reports and systems (BIRADS and so on), check list.

- Do not forget a careful proof reading !
- Beware of speech recognition systems…

- Before completing, ask yourself : «what do I want the referring physician to conclude?»
- Recommendations should be clear and physician should be reached and informed
- Do not relinquish to the physician the significance of your report: you are the expert

Error in report: VR vs Transcription

Basma (AJR 2011):

- 23% of VR reports with errors vs 4% for transcriptionists

Chang (J Digit Imaging, 2011):

- 11% of CR (X Rays) reports contained errors; 2% nonsense errors.
- 36% of non-CR reports contained errors; 5% nonsense errors.

Quint (J Am CR 2008):

- 22% error rate in cross sectional reports.
- 76% of radiologists believed their error rate was <10%.

Hamana (Health Information Management Journal, 2015)

- Percentage of reports containing at least one error between 4,8 to 89 % for VR and 2,1 to 22 % for usual transcription.
- Average turnaround reduced by 35 % to 99 %.
- Longer dictation time.

Legal Issues

Legal issues

Malpractice claims:

1. Observer errors
2. Errors in interpretation
3. Failure to suggest the appropriate study
4. Failure to communicate timely in an appropriate manner

- Variable consequences, minor vs major errors
- Strong incentive for taking care of errors
  - Human errors
  - System errors
- Cost of litigations
- Different systems
- Expertise and hindsight bias…

Failure to order a radiologic exam

Defensive medicine
accounts for 5 to 9 % of healthcare costs in USA.

Cook county (IL)

	Total of Malpractice Lawsuits	Radiology Related Lawsuits	Failure to order radiological examinations
1982	1103	127	23 (2%)
1992	992	112	39 (3,9%)
2002	1029	130	56 (5,4%)

Berlin L AJR, 2005

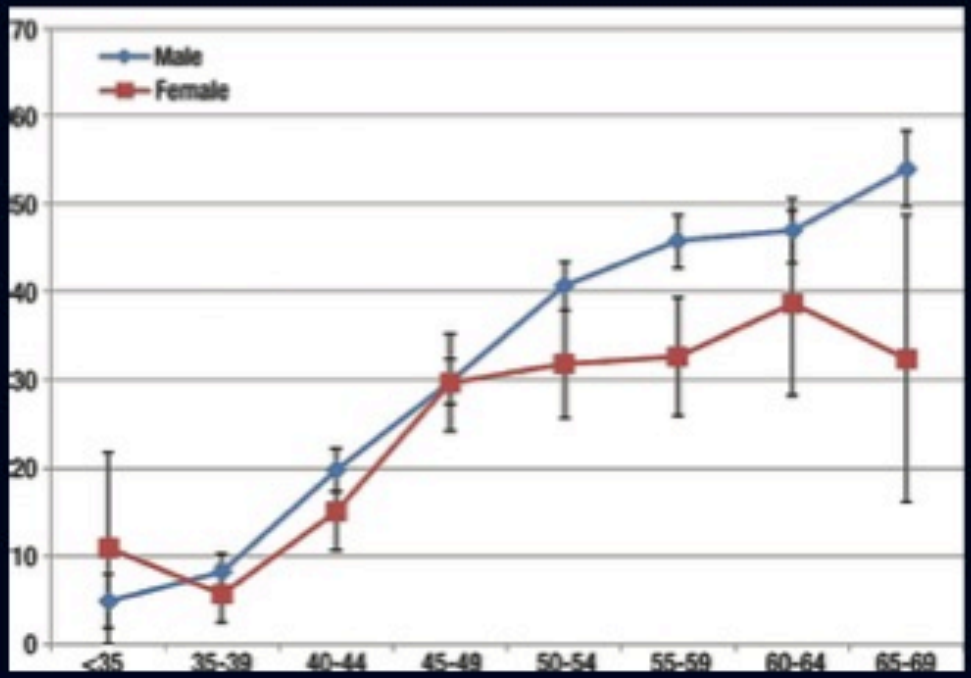
Pressure on cost containment versus litigation costs ???
Yes, but the clinician is not expected to be aware of the limitations of every radiologic study ! (Babu S, Radiographics 2015)

France: the judge!

- No specific rules
- Complex procedures
- Fault: broad definition..
- Report +++
- Experts…
- Simple principles: fault/ damage/relationship between the two
- At the end: the judge!

D. Truchet (Paris, Assas, 2009)

USA: the jury!



Percentage of radiologists with history of at least one malpractice suit, disaggregated by age and sex.
As radiologists progress in their careers, the accumulated risk of ever being sued approaches 50%. Male radiologists of every age group are more likely to have been sued than their female colleagues of the same age.

Baker S, Radiology 2013

CHICAGO MEDICAL MALPRACTICE ATTORNEY BLOG - RADIOLOGY ERRORS

$4.39 Million Jury Verdict for Late Diagnosis and Treatment of Cancer

Sean Pedley was 43 when he developed a lump in his left thigh. An internist, Dr. Syed Danish, ordered an x-ray that did not signify or later lead to…

Failure to Timely Diagnose Lung Cancer Leads to Settlement of $1.47 Million

Gerald Teeuwen, 77, developed a persistent cough. He went to an urgent care facility and later underwent a chest x-ray, which was interpreted as…

$425,000 Jury Verdict for the Wrongful Death Caused by Misread CT Scan

Gretchen Altemus, 68, struck her head in a fall. She went to the Indiana Regional Center emergency room where she underwent a CT scan. The…

- Median payment awards: 1 to 14: $24 105 (Colorado) to $350 000 (Oregon)
- Lower risk of suit in Alabama (0.95/y) and higher risk in NY (5.65/y).
- Male > Female

Know how to handle a claim

- Be honest if you make an error: do not either argue nor ignore it.
- Be polite and listen to the complaint.
- Review the concern.
- Call back the clinician and the patient and verify if the error is for real.
- Thank them for recognizing the problem and ensure them that is a rare event that your are taking seriously.
- Give the corrected information, a new report or an addendum.
- Suggest a plan and stick to it.
- Record the case and document the remedy.
- Learn from your mistakes (and other's).

REMEDIES

- Technology: enormous progress!

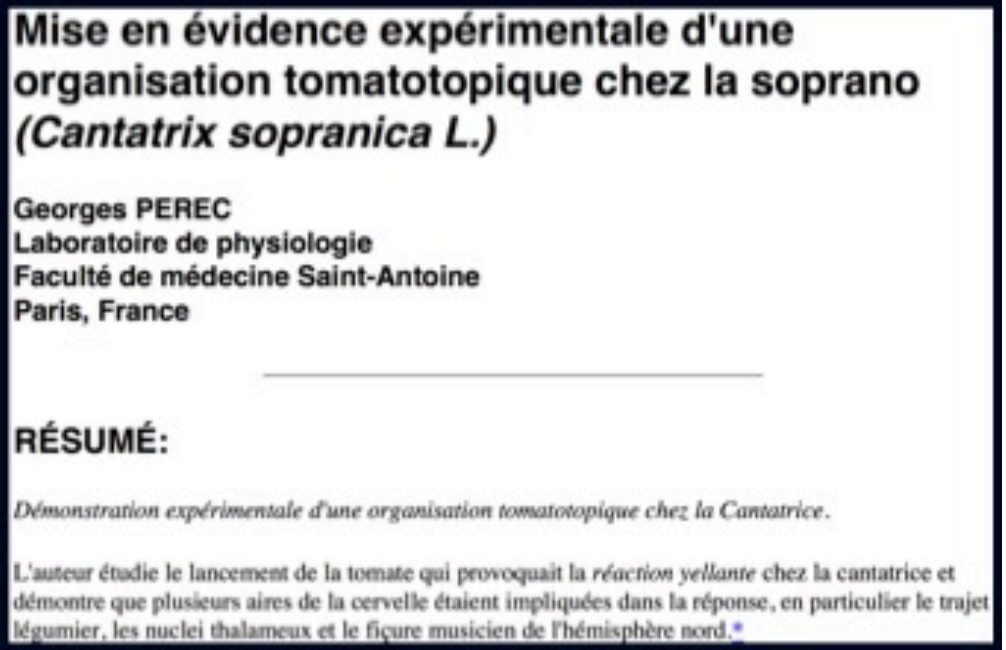
But human eye and brain?

- High level of expertise?

Does not immunize against inherent limitations of human attention and perception…

Means of assessing errors

- Person centred: focus on the individual
  - Attractive from managerial and legal p.o.w.
  - Ill suited to the health care domain (NHS 2001)
- System based
  - Humans are fallible and errors are inevitable
  - Address the contributing causes for these errors
- Concept of Root Cause Analysis (Murphy, 2008)
  - What happened ?
  - Why did it happen ?
  - What can be done to prevent recurrence ?



Mise en évidence expérimentale d'une organisation tomatotopique chez la soprano *(Cantatrix sopranica L.)*

Georges PEREC
Laboratoire de physiologie
Faculté de médecine Saint-Antoine
Paris, France

RÉSUMÉ:

Démonstration expérimentale d'une organisation tomatotopique chez la Cantatrice.

L'auteur étudie le lancement de la tomate qui provoquait la *réaction yellante* chez la cantatrice et démontre que plusieurs aires de la cervelle étaient impliquées dans la réponse, en particulier le trajet légumier, les nuclei thalameux et le ficure musicien de l'hémisphère nord.*

 Remove any punitive elements from the process of error analysis and instill a blameless culture

Bruno et al, Radiographics 2015

(NHS) Risk assessment (1)

- Step 1: Level of discrepancy/error: score should reflect the magnitude of error and clinical impact.

Score	Impact	
1	Negligible	No ill effects
2	Minor	Minimal ill effects
3	Moderate	Error resulting in short term ill effects
4	Major	Error resulting in long term ill effects
5	Extreme	Error resulting in severe long term ill effects or fatal ill effects

(NHS) Risk assessment (2)

Step 2: evaluate proof of competence, patterns of practice/use of proper techniques

System Factors	Score
Clinical team working environment	5
Audit	5
Case conferences	5
Appropriate workload	5
PACS/Available clinical information	5
Discrepancy meetings	5
Modern equipments	5
Trained radiographic staff	5

Professional Factors	Score
Experienced	8
Working in a radiology team	8
Case conferences	8
CPD/CME	8
No health/stress issues	8

(NHS) Risk assessment outcome

Risk matrix

- Level 1: local resolution desirable.
- Level 2: local resolution possible. Audit of activity. If persistent concern, external audit.
- Level 3: internal council and external audit with 3 radiologists in the same reporting conditions. If problem confirmed, retrospective audit and review of previous studies. Patients informed.

Remedies ?

- Personal: tips
- System
  - Local
  - General

Personal remedies: Tips

1. Know that you have tendency to make errors…
2. Reflect on how you think and how you decide
3. Shelter your working environment
4. Are you the right person for the case?
5. Take your time and do not be pressured
6. Try not to interpret while reading the case
7. Gather as much information as possible, but beware of the framing gap: look at the examination first without clinical data
8. Train your brain to see without seeing
9. Think horses but be prepared for zebra
10. Be always prepared to consider a differential diagnosis: it is not always what it looks!
11. Ask a colleague
12. If in doubt, think out loud and suggest adequate solution.

System remedies (Local)

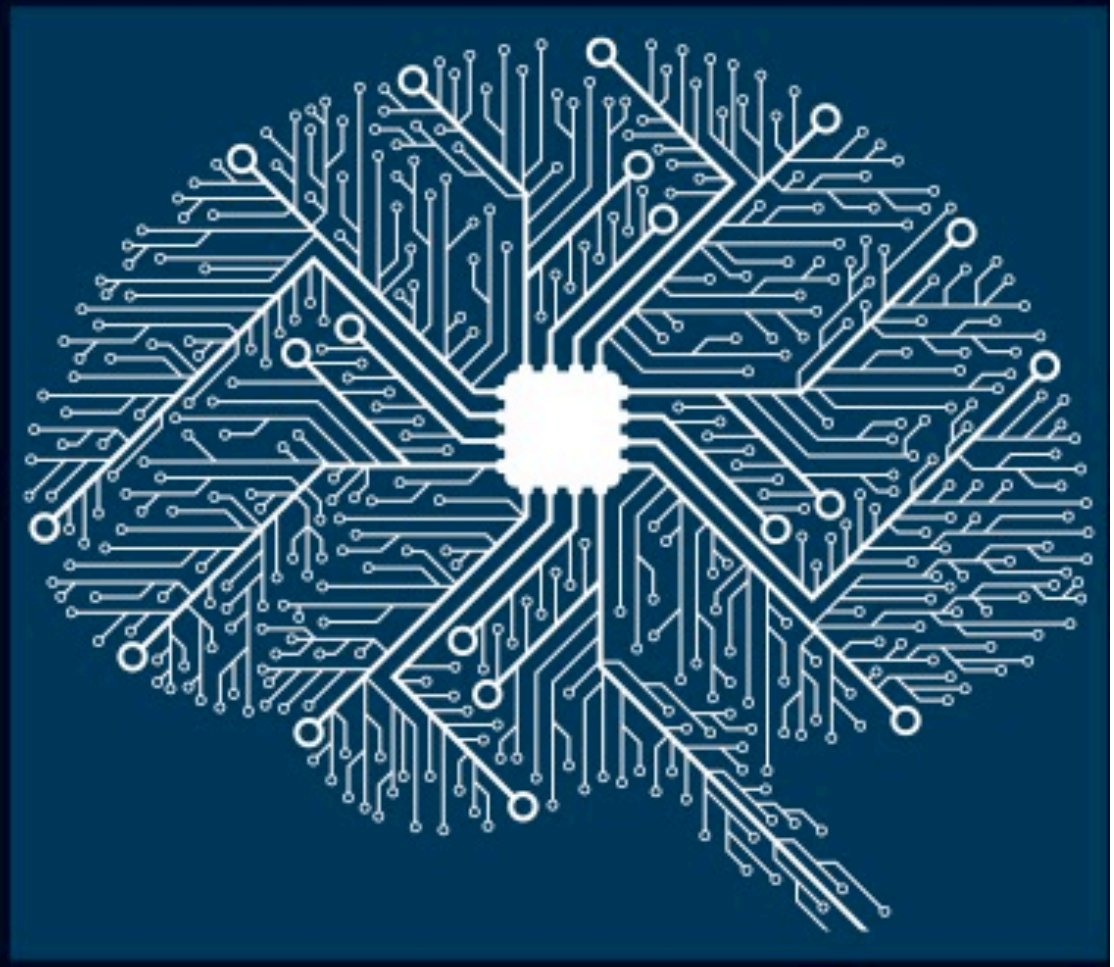
1. Adequate medical and para-medical staffing according to workload.
2. Procedures and organization follow-up: accreditation, task review, attention to potential burn out.
3. Adequate equipment, including CAD systems.
4. In house peer-review process.
5. Real time double reading in high risk cases (CT+++).
6. Double reading (screening, difficult case).
7. CME, in house training and reviews.
8. Error/discrepancy meetings and follow up.

System remedies (General)

1. Facilitate more effective teamwork in the diagnostic process among health care professionals, patients, and their families
2. Enhance health care professional education and training in the diagnostic process
3. Develop and deploy approaches to identify, learn from, and reduce diagnostic errors and near misses in clinical practice
4. Ensure that health information technologies support patients and health care professionals in the diagnostic process
5. Establish a work system and culture that supports the diagnostic process and improvements in diagnostic performance
6. Develop a reporting environment and medical liability system that facilitates improved diagnosis by learning from diagnostic errors and near misses
7. Design a payment and care delivery environment that supports the diagnostic process
8. Provide dedicated funding for research on the diagnostic process and diagnostic errors

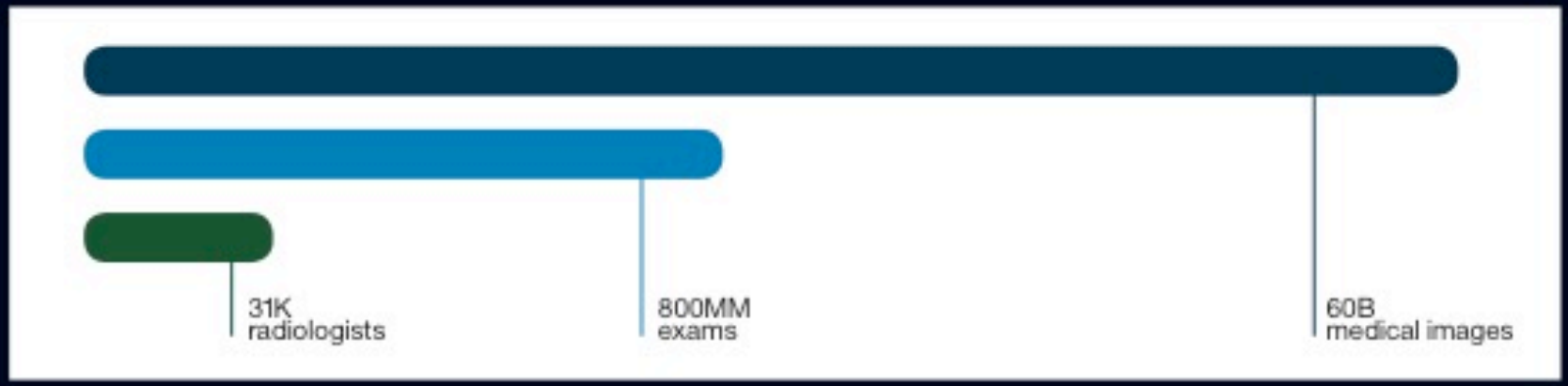
Balogh EP, The National Academy Press 2015

AI?



"See expansively, recognize reliably and communicate objectively"

Artificial Intelligence ?



USA 2015 : 31 000 Rads/800 M Multi-slice exam./60 B images = 2 images/sec for one year

Future of Radiology

From Radiology 1.0

Through Radiology 2.0

To Radiology 3.0: patient centred
Personalized medicine and "radiomics" (data base)

Decrease barriers
to communication with
referring physicians and patients

Modern tools ?
Battle for the big data…

CONCLUSION

- Be humble: radiology is the most humbling specialty
- Maximize your chance to do as well as possible (switch off your smartphone…)
- "Do not let the fear of being wrong rob you of the joy of being right" (Rogers LF)
- In case of an error: be honest and handle the case…