



**COALITION  
TO IMPROVE DIAGNOSIS**

**Improving Diagnosis:  
A Strategic Priority in  
Pennsylvania**

*By Rebecca Jones, MBA, BSN, RN,  
CPHRM, CPPS*

The Pennsylvania Patient Safety Authority (PSA) is an independent state agency established under the Medical Care Availability and Reduction of Error (MCARE) Act of 2002. PSA is charged with taking steps to reduce and eliminate medical errors by identifying problems and recommending solutions that promote patient safety. MCARE requires Pennsylvania healthcare facilities to report “serious events” (events that have caused harm to patients) and “incidents” (events that have not caused harm to patients) to PSA, which collects and analyzes the data. Facilities have been reporting these events through the secure, web-based Pennsylvania Patient Safety Reporting System (PA-PSRS) since June 2004. PSA’s role is non-regulatory and non-punitive and is distinguished from the role of other state agencies involved in regulating and/or licensing healthcare facilities and providers.

PSA first addressed the topic of diagnostic error in 2010 by publishing an article, “Diagnostic Error in Acute Care,” in its

*continued on page 5*

**Perceptual Errors and the Limits  
of Visual Performance**

*By Susan Carr*

Not all errors are created equal, especially in medical imaging. Some are familiar and common in medicine; others, such as perceptual errors, are specific to radiology and difficult to correct.

Some errors that occur in imaging are well represented in the patient safety taxonomy: medication administration mix-ups, patient misidentification, and delayed or derailed critical test results.<sup>1</sup> Errors caused by a range of factors, including poor design, equipment miscalibration, inadequate training, and understaffing, can affect image quality and radiation exposure or put patients and staff members in danger of serious injury.<sup>1,2,3</sup> That these errors and problems are familiar doesn’t mean they are easy to avoid, but they are largely understood. In many cases, solutions exist that have been proven to mitigate or prevent the harm these errors can cause.<sup>1</sup>

In radiology, diagnostic errors occur most often during image interpretation, which includes the visual or perceptual phase of viewing and reading, as well as cognitive processing.<sup>4</sup> Interpretation is a complex psychophysiological process, prone to a variety of errors that resist commonly used reduction efforts, such as forcing functions, redundant processes, or improved training.

Researchers estimate errors occur during interpretation at a rate of between 3.5% and 4% in an “everyday mixture of abnormal and normal cases.”<sup>5(p1175)</sup> In studies where radiologists read a sample of images known to have abnormal findings, the error rate is roughly 30%.<sup>5</sup> Mistakes in the perceptual or viewing phase of interpretation, where radiologists fail to identify abnormalities while reading the medical image (false negatives) or mischaracterize normal tissue (false positives), are the most prevalent errors in radiology.<sup>4</sup> These failures in visual performance are estimated to account for between 60% and 80% of the 3.5% to 4% of cases in which radiologists commit errors.<sup>4,6,7</sup>

Perceptual errors are not well understood and are especially challenging to mitigate. Being highly trained and practicing at an advanced level of expertise does not fully protect radiologists from making perceptual errors. According to radiologist Michael Bruno:

*... radiologists’ training does improve their image-interpretation skills very dramatically, but random perceptual errors still occur, the reasons for which are unclear... [They] seem intractable to remediation, occur spontaneously and unpredictably, and*

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## Perceptual Errors

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*the observer is totally unaware of them (email communication, August 1, 2017).*

It is generally accepted that there is an upper limit to the level of visual performance a radiologist can achieve.<sup>4</sup> Error rates for radiology have not changed much since L. Henry Garland published the first articles about errors in radiology in the 1940s and 1950s.<sup>8,9</sup> In 1997, British radiologist P. J. A. Robinson observed that although imaging technology had greatly improved during the 20th century, “performance of the human eye and brain” had not.<sup>7(p176)</sup> Referring to Garland’s work, radiologist Leonard Berlin commented in 2014 that “...the missing of an overt lesion remains as much a mystery and enigma today as it was 61 years ago.”<sup>6(p81)</sup>

### Addressing Perceptual Errors

Perceptual errors are not just common, they are foundational in that they precede the medical interpretation most lay people would assume is the complicated and difficult part of formulating or reaching a diagnosis. An error in reading the image makes a diagnostic error nearly inevitable.

*... the sequential nature of this decision process ensures that, if an error is made in the search process, it is unlikely that the correct diagnosis will be made.*<sup>10(p272)</sup>

***An error in reading the image makes a diagnostic error nearly inevitable.***

As with all medical errors, perceptual errors must be defined before they can be counted and analyzed; some abnormalities in radiographs are missed because they are subtle or ambiguous, not due to a reading error. Like other elements of human performance, visual acuity can be affected by elements of the practice environment, such as distractions, interruptions, fatigue, and viewing conditions.<sup>4</sup> Visual performance is also vulnerable to cognitive biases, such as “satisfaction of search” (when finding something leads to suspending a search that had been continued would have resulted in finding other problems). Even with all of those contributing factors taken into account, most perceptual errors happen without obvious cause. “All too often, a finding that is readily apparent in retrospect is inexplicably missed.”<sup>4(p1670)</sup>

A second reading—performed either by human or computer—will compensate for some perceptual errors.<sup>4</sup> Having two radiologists read

each image puts obvious stress on workforce and financial resources, and computer-aided detection, used primarily in mammography, has not improved cancer detection or lowered error rates.<sup>6</sup>

### Understanding Visual Search

Looking for abnormalities on medical images—visual search—is the baseline activity and expertise of radiologists.<sup>11</sup> Even if it is not possible to improve optimum human performance with this skill, it is important to understand how visual search works, what search strategy is most effective, and how best to teach it.

How to approach reading an image—eg, systematically, focusing sequentially on one section of the image at a time; selectively, focusing first on areas assumed to be of highest priority, sometimes informed with clinical history; or intuitively, scanning more globally, based on experience and knowledge—is one area of recent study. If one approach emerges as clearly superior, can it be taught effectively to radiologists in training?

Kok et al.<sup>12</sup> studied three related questions: 1) How does systematic viewing relate to full coverage of an image and to diagnostic performance? 2) Do systematic viewing and coverage increase with expertise? 3) Do students who are trained in systematic and full-coverage viewing perform better when reading chest radiographs?

The study produced extensive, detailed results, but the bottom line finding for students and experienced radiologists was that neither systematic viewing nor increased coverage improved accuracy and diagnostic performance. The authors observe:

*... the assumed relationship between coverage of an image and diagnostic performance presumes that when an abnormality is looked at, it is actually detected. This assumption is probably too strong, even for experienced radiologists. ... This implies that the simple act of fixating your eyes on an abnormality is often not enough to detect it.*<sup>12(p200)</sup>

Hoping to inform the training of radiologists, researchers in the Netherlands have asked, “How do visual search characteristics relate to diagnostic performance in radiology?”<sup>13(p2017)</sup> They performed a review of published literature based on a search for the terms “radiology,” “visual perception,” “eye tracking” and their synonyms. They reviewed 22 articles published between 1994 and 2014. Similar to the study performed by Kok et al., their findings advanced the science of visual perception but did not

*Training novices to search like experts before they have the experience required for expertise is likely to be an empty exercise and perhaps invite unintended consequences.*

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reveal a clear path to improved performance or education.

These and other studies have found that experience and knowledge distinguish high-performing radiologists and influence the way they visually search images.

Understanding the search techniques experts employ is valuable, but what is learned about their techniques may not be transferable. Training novices to search like experts before they have the experience required for expertise is likely to be an empty exercise and perhaps invite unintended consequences.<sup>12</sup>

Jeremy Wolfe and his colleagues at the Visual Attention Laboratory at Brigham and Women's hospital in Massachusetts are also exploring what traits characterize expertise in radiologic visual search and how to impart them to trainees. In one study, they found that radiologists perform better than "expected by chance"<sup>10(p263)</sup> when viewing a chest radiograph for one-fifth of a second, a time too short to be subject to purposeful or even ingrained search behaviors. With nonselective processing, expert radiologists appear to take in the entirety of the image in a glance and somehow glean whether or not it contains an abnormality. To refute the proposition that expert radiologists are simply visual wizards, the researchers cite an earlier study<sup>13</sup> that found radiologists were no better than average at nonmedical visual searches (including the *Where's Waldo?* series of children's books). The Visual Attention Laboratory researchers conclude that expertise in radiologic visual search is specific to domains and based on experience.<sup>10</sup> They also point out that with as the volume of medical images radiologists must process explodes, the need to figure out how best to train them for optimal performance is increasingly urgent.

### Accepting Error

Understanding what makes a radiologist a high-performing diagnostician or simply effective at seeing abnormalities in medical images is important but does not address the underlying, universal, innate limitation of perceptual error. Although there are many aspects of their practice that can and will be improved, radiologists can expect to see and miss as many abnormalities today as they ever have.

Accepting the inevitability of human error is a central concept in patient safety, and there are many effective ways to prevent some errors from causing harm, eg, employ technology, apply principles of human factors engineering, and

improve organizational culture. The resulting improvements may be significant, but they do not effectively address diagnostic errors caused by interpretive and perceptual errors. Using radiologists for second readings can help, and computer-aided detection will continue to improve; in the meantime, studying visual perception will help deepen our understanding of human performance and respect for the persistence of human error.

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# Diagnosing Diagnostic Error

## *An appreciation of the work of Lawrence Weed, MD (1923-2017)*

By Art Papier, MD

As we mourn the passing of Lawrence Weed, the father of the problem-oriented medical record (POMR), the SOAP note format, and problem-knowledge couplers,<sup>1,2</sup> we also celebrate his life and ideas. Weed is known best, even in the SIDM community, for those contributions and for his travels across the country in the 1970s, during which he advocated standardizing the medical record as an aide to guide thinking. However, even in our diagnostic error community, some may not be aware of Weed and his life's work and accomplishments, including important messages about reducing harm from diagnostic errors.

Close to 50 years ago, Weed began to articulate ideas that put him well ahead of his time:

1. The unaided human mind is insufficient to handle the complexity of diagnosis.
2. In addition to not being able to recall all the relevant diagnoses within a differential diagnosis, the unaided human mind cannot remember all the questions to ask around presenting complaints. Software can and should be used to collect a complete data set.
3. Without feedback loops, there is little accuracy and no true learning.
4. Patients need to be central to their care and participate in the diagnostic and management process.
5. Students and doctors should be scored on a core of behavior and skills, not on a "core of knowledge."

This is a short list. There are dozens more pearls in Weed's writing and critique. I recommend starting with "Diagnosing Diagnostic Failure," which appeared in the first issue of SIDM's journal, *Diagnosis*.<sup>3</sup> Those who want to dig deeper should consider reading his book, *Medicine in Denial*,<sup>4</sup> written with his son, Lincoln Weed.

I strongly recommend watching Weed's 1971 Internal Medicine Grand Rounds at Emory University, which is available on YouTube,<sup>5</sup> and a 7-minute remembrance of Weed<sup>6</sup> produced by my colleague Noah Craft, who is also producing a documentary about Weed and his ideas.

I believe that if Weed had participated in a Diagnostic Error Meeting, he would have taken our community to task. He did not believe that fixing diagnosis would come through modifying

medical education, and he certainly did not believe in "cognitive de-biasing." Weed believed we need an information architecture and software to augment our brains. He did not mean artificial intelligence, but a standardized system to help gather patient data and process it, with the patient at the center and the care team as partners.

Larry Weed was an incredible human being who had a lasting impact. I was lucky to know him.<sup>7</sup>

*Art Papier is CEO of VisualDx, associate professor of dermatology and medical informatics at the University of Rochester in New York, and a member of the board of directors of the Society to Improve Diagnosis in Medicine. He may be contacted at [apapier@visualdx.com](mailto:apapier@visualdx.com).*

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## Diagnosis: A Strategic Priority in Pennsylvania

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quarterly newsletter, the *Pennsylvania Patient Safety Advisory*.<sup>1</sup> The article highlighted some of the cognitive biases identified in the literature as contributing to this problem, illustrated by exemplar cases reported to PSA. The article included links to a [chart-auditing tool](#) and [worksheet](#) to calculate relevant process and outcome measures, a [research poster](#) illustrating common causes of diagnostic errors, a [provider checklist](#), and [patient education](#).

During 2016, the PSA Board of Directors and staff members engaged in a strategic planning process and identified 4 pathways for enhancing the Authority's foundational work under the MCARE Act. One of those pathways is focused on improving diagnosis.

PSA has developed several strategies aimed at enhancing awareness and designing approaches to identify and learn from events related to diagnosis:

- In October 2016, PSA joined the Coalition to Improve Diagnosis and committed to enhancing awareness and taking action to improve diagnosis. Membership in the Coalition has enabled PSA to establish connections and engage partners from like-minded organizations working to achieve diagnostic excellence.
- PSA is developing a methodology for identifying and categorizing diagnostic errors among the events reported to the PA-PSRS database. PSA plans to update the database to better capture reports that involve errors or process failures related to diagnosis. PSA hopes that this work ultimately will provide guidance to individuals, facilities, and organizations that have not yet embarked on analyzing events to find diagnostic errors.
- PSA has also partnered with the Health Care Improvement Foundation in a 2-to-3 year demonstration project aimed at identifying and reducing radiologic diagnostic errors in emergency departments. This program is one of 14 areas of focus under the Hospital and Healthsystem Association of Pennsylvania's "Partnership for Patients" Hospital Improvement Innovation Network funded by

the Centers for Medicare and Medicaid Services. There will be a presentation about this project during the pre-conference workshop, "Reducing Diagnostic Error on Clinical Settings," at the Diagnostic Error in Medicine conference in Boston, Massachusetts, on October 8, 2017.

- In 2018, PSA will host its first statewide conference, which will include diagnostic safety among the topics covered by speakers and in workshops. The Pennsylvania Patient Safety Summit will take place on April 5, 2018, in State College, Pennsylvania. As plans develop, information will be posted on the PSA website (<http://patientsafety.pa.gov/>).

*Becky Jones currently serves as director of innovation and strategic partnerships at the Pennsylvania Patient Safety Authority. In that capacity, she leads PSA's innovation efforts, develops and maintains relationships with key strategic partners, provides administrative oversight of its infection prevention and collaborative programs, and guides the strategic focus on improving diagnosis in healthcare. Jones serves on the Practice Improvement Subcommittee of the Society to Improve Diagnosis in Medicine and represents PSA as a member of the Coalition to Improve Diagnosis. She may be cocontacted at [rebejones@pa.gov](mailto:rebejones@pa.gov).*

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The Coalition to Improve Diagnosis, comprised of leading healthcare organizations, has been established to bring awareness, attention, and action to the problem of diagnostic error. SIDM established and leads the Coalition. To learn more, and to view a list of the Coalition's 31 members, visit [www.DxCoalition.org](http://www.DxCoalition.org).



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# Wears Remembered as Teacher, Researcher, and Thought Leader in Patient Safety

By Shawna J. Perry, MD, FACEP



Robert L. Wears, MD, MS, PhD

Robert “Bob” L. Wears, MD, MS, PhD, distinguished professor of emergency medicine at the University of Florida College of Medicine–Jacksonville, died peacefully on July 16, 2017, with his family at his side.

Known as a teacher, researcher, and thought leader in patient safety, Bob also practiced emergency medicine for nearly 40 years, which made the problem of diagnostic error a natural focus of his attention. He was a longstanding contributor and friend to the Society to Improve Diagnosis in Medicine (SIDM). The Diagnostic Error in Medicine conference series, led by SIDM since 2006, originated from discussions with Bob and others at a meeting in Naples, Florida, in 2005.

Bob was considered a breakthrough thinker in diagnostic safety, applying principles of human factors and systems engineering to illustrate the complexity of clinical work and its contribution to medical diagnosis. In his writings, he underscored the problem of hindsight bias and cautioned against superficial explanations for the origins of failure in medicine. His description of diagnostic error as a “wicked problem” is recognized as an accurate and important observation in light of medicine’s high-risk sociotechnical work system. Bob also wrote widely about resilience in healthcare and the often overlooked importance of the human role in clinical success and risk mitigation.

Bob attended Johns Hopkins University for his undergraduate and medical degrees. In 2011, he completed a PhD in industrial safety at the Crisis

& Risk Research Centre at Mines Paris Tech in Sophia Antipolis, France.

Bob was an influential scholar and thought leader on many fronts related to safety in healthcare. In addition to his position at the University of Florida, Bob held professorships at the Imperial College School of Medicine (London), Institute for Health Innovation at Macquarie University

(Sydney, Australia), and at the University of Southern Denmark. He wrote and published over 400 papers, books, and book chapters related to patient safety, human factors, and the development of resilient healthcare. Bob sat on the editorial boards of 10 major medical and patient safety journals and was a reviewer for 38 more. He was also an active researcher, receiving over \$8 million dollars in research funding during his career to investigate patient safety-related topics. Bob received a Robert Wood Johnson Foundation Investigator Award in Health Policy Research to study and write a history of the patient safety movement, which is currently being edited by Oxford University Publishing.

Bob mentored many people across the United States and on several continents. He made anyone seeking his counsel feel they had been heard, no matter how brief the encounter. Bob shared his thoughts freely and always in support of others. Everything was interesting to him, and he greatly enjoyed the repartee of a scholarly life. He was known for his compassionate nature and gentle manner with patients, students, and residents in training, as well as for his remarkable diagnostic skill. Bob touched the lives of millions through his dedication and service to the institution of healthcare.

Those who knew him well knew that his greatest love was for his family. He was steadfastly devoted to Diane, his wife of 45 years. His 2 children (Matt and Sarah) and 6 grandchildren likewise brought him much happiness. Bob was often a man of few words, but his quick wit and humor were always evident. His vast repertoire of jokes, puns, and sayings was well known to his family and friends. After a good meal, Bob enjoyed saying, “It couldn’t have been better, but there could’ve been more.” His family, friends, colleagues and admirers feel the same way about his full and well-lived life.

*Shawna Perry is associate professor in the department of emergency medicine at the University of Florida College of Medicine–Jacksonville and was a research partner, mentee, and “second daughter” of Bob Wears. Perry may be contacted at [Sjpm1@gmail.com](mailto:Sjpm1@gmail.com).*

## Suggested Readings

### What makes diagnosis hard?

Wears RL.

*Adv Health Sci Educ Theory Pract.*

2009;14(Suppl1):19–25.

doi:1007/s10459-009-9181-3.

### Resilient health care: turning patient safety on its head

Braithwaite J, Wears RL, Hollnagel E

*Int J Qual Health Care.* 2015;27(5):418-42.

doi:10.1093/intqhc/mzv063

# Physician Distrust of “Dr Google” Predates the Internet

By Susan Carr

In the latest issue of *Diagnosis*, Annemarie Jutel examines how physicians have reacted to patients who consult sources of information on their own to learn about their diseases and conditions. Patient access to information is currently a hot topic, but Jutel traces the debate back through more than 100 years. Often, the patients who are seen to be disruptive are attempting to self-diagnose prior to consulting a physician.

Reviewing literature from the late 19th through the mid-20th century, Jutel attributes physician distrust of meddling, curious patients to professional protectionism and paternalistic concern. She draws parallels to current debates about the role of “Dr Google,” observing that many physicians disapprove of their patients’ freelance pursuit of online sources of information and advice.

Although the Internet has transformed access to information, Jutel finds the dynamics of the debate have more to do with social roles related to authority than with new sources of information. She notes that in the early days of scientific medicine,

*... diagnosis became the tool by which they [doctors] exercised their authority.... The social function of diagnosis was to differentiate not only the doctor from the quack but also the doctor from the patient.*<sup>1(p87)</sup>

In addition to protecting their turf, physicians have been genuinely concerned throughout modern medicine that proactive patients may cause themselves needless anxiety, contribute to overdiagnosis and overtreatment, or be taken advantage of by commercial interests and con artists who prey on the sick, worried, and impressionable.

Jutel’s main focus is on self-diagnosing patients, but she also looks at physician reactions to patients who seek information for more general, educational purposes. She agrees with oncologist Frank Rector who recognized in 1936 that patients should participate in medical progress: “With the new information that is accumulating daily, and with the intelligent lay interest, the outlook is bright.”<sup>2(np)</sup>

Other articles in the current issue of *Diagnosis* include a report about an AHRQ Diagnostic Safety Research Conference, the use of diagnostic pathways to study diagnostic performance, analysis of lab-related errors reported to an online system in Canada, results of a survey of healthcare organizations on their interest in addressing diagnostic error, and error types in visual assessment.

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