Future of Malpractice in a World of Mid-levels, AI and Other Radiologist Substitutes

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Chief Medical Officer, The Radiology Leadership Institute of the ACR

Disclosures

- I am a former venture capitalist and I occasionally do VC consulting. This is not relevant to the content of this talk
- I have been an expert witness in both injury and med-mal cases

Goals for this talk

- 1. Review the scale and scope of malpractice impacts on US radiology
- 2. Examine how APPs affect medical malpractice risk to radiologists
- 3. Understand scenarios for how AI may change malpractice risks

Wicked Problems

- In planning and policy, a **wicked problem** is a problem that is difficult or impossible to solve because of incomplete, contradictory, and changing requirements that are often difficult to recognize. It refers to an idea or problem that cannot be fixed, where there is no single solution to the problem; and "wicked" denotes resistance to resolution, rather than evil.[1] Another definition is "a problem whose social complexity means that it has no determinable stopping point"

- https://en.wikipedia.org/wiki/Wicked_problem accessed Jan 28, 2023

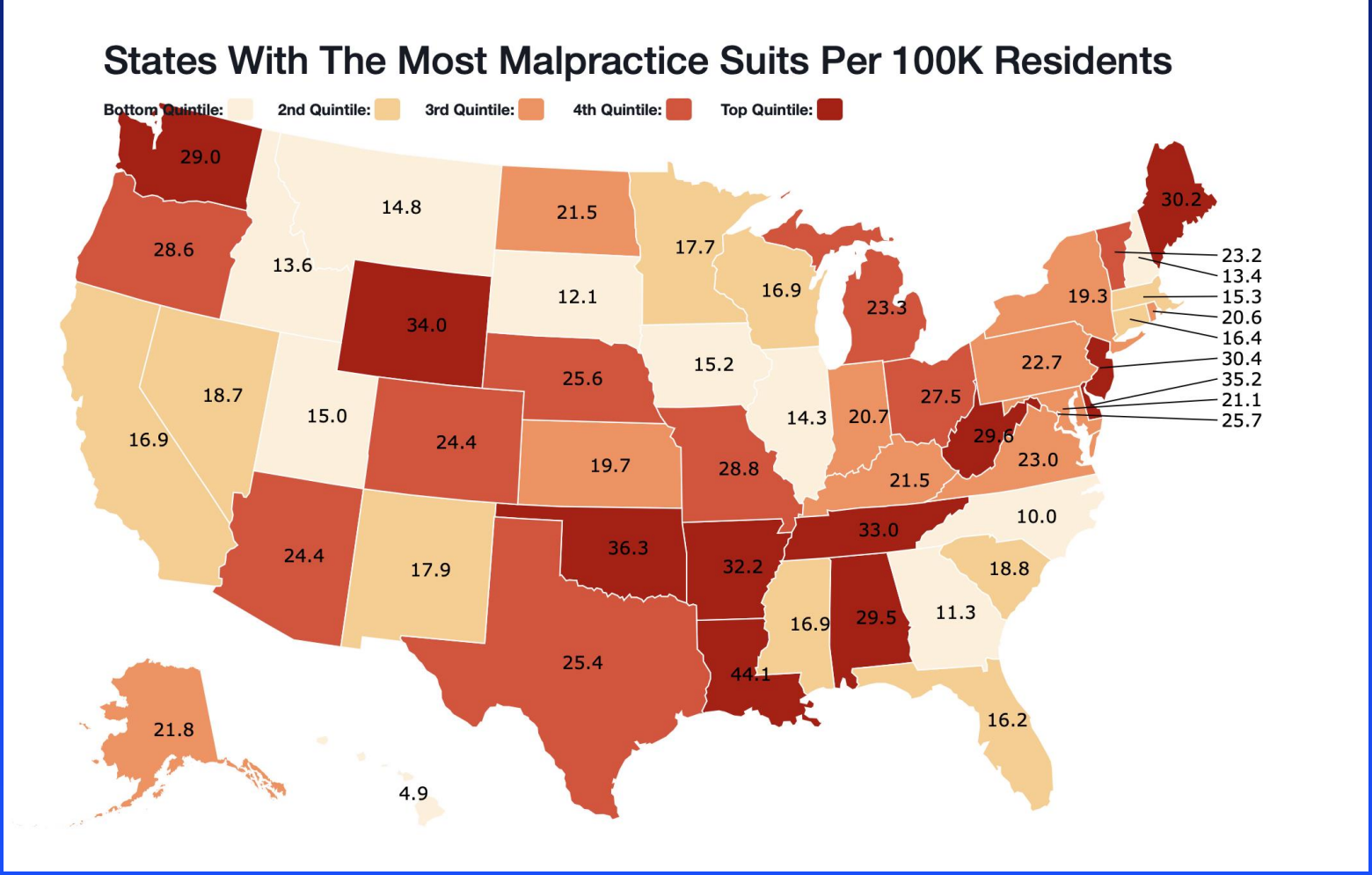
"Here's to the crazy ones, …They push the human race forward, and while some may see them as the crazy ones, we see genius, **because the people who are crazy enough to think that they can change the world, are the ones who do."**

Four key elements for malpractice

- 1) that the radiologist owed the patient a legal duty of care;
- 2)that there was a breach of this duty;
- 3) that there was resultant injury or damages; and
- 4) that the radiologist's breach was the proximate cause of the injury or damages

Eisenberg RL. *Radiology and the law: malpractice and other issues.* Springer-Verlag, 2004

Variability



https://research.zippia.com/states-that-sue.html

If APPs are the Answers what is/are the driver(s)?

Improve quality of imaging interpretations

Drive down the cost of health care

Failure to train and and maintain adequate number of active radiologists for the volume of imaging in the US

APPs and Quality: How hard is it read a head CT?

- One way to answer this is to ask how many things you need to check
- Another way is to pull out some textbooks: neurology, trauma, ID, inflammatory diseases, etc. and ask how many pathological entities affect the head and neck

APPs and Quality

How many hours of training do you need to read a CT safely? 10,000? 2000? 100? A weekend?

Could (will) there be both a physician standard and a (lesser) non-physician standard of care?

APPs and Cost

Shots HEALTH NEWS FROM NPR

SHOTS - HEALTH NEWS

ERs staffed by private equity firms aim to cut costs by hiring fewer doctors

February 11, 2023 · 7:00 AM ET

BRETT KELMAN BLAKE FARMER

FROM KHN

4-Minute Listen + PLAYLIST

APPs and Cost

3-year study of NPs in the ED: Worse outcomes, higher costs

MAR 10, 2023 • 3 MIN READ

Kevin B. O'Reilly
News Editor

PRINT PAGE

Bookmark

Nurse practitioners (NPs) delivering emergency care without physician supervision or collaboration in the Veterans Health Administration (VHA) increase lengths of stay by 11% and raise 30-day preventable hospitalizations by 20% compared with emergency physicians, says a working paper published by the National Bureau of Economic Research.

Private Equity – Mid-long term care consequences

OPINION

Private Equity–Backed Hospital Investments and the Impact of the Coronavirus Disease 2019 (COVID-19) Epidemic

Frank J. Lexa, MD, MBA, Frank James Lexa

INTRODUCTION

The severe acute respiratory syndrome coronavirus 2 pandemic (SARS-CoV-2 [COVID-19]) has crippled the American medical system in early 2020 by reducing both the demand for and access to elective medical care in much of the nation. In the radiology sector alone, initial forecasts

corporatization of US health care services over the past decade, which includes hospitals, clinics, urgent care facilities, as well as both primary and specialty care practices [4]. The private equity (PE) investment model has significant known downside risks. The reliance on leveraged buyout financing puts firms at a higher risk of

publicly traded, or occasionally in the process of taking public companies private). The goal is to boost short- and medium-term firm performance by using strategies such as restructuring and hands-on management to build the investment for a sell or liquidity event.

In the best circumstances, the PE model succeeds in building value in

If APPs are the Answers what is/are the question(s)?

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Failure to train and a maintain adequate number of active radiologists for the volume of imaging in the US

The Radiology Labor Market

- How big is the US radiology job market? Number of FTEs?

  34,000

- England has 48 trained radiologists per million, about half of Germany's level of 92 per million, and less than other European countries (Spain, 112 per million and France, 130 per million). The U.S. has approximately 34,000 radiologists, or **100 per million** according to the Journal of Nuclear Medicine

A head CT in 2023 is not a 1989 CT

In 1989, a neuroradiologist interpreting head CT scans was required to interpret ~37 images

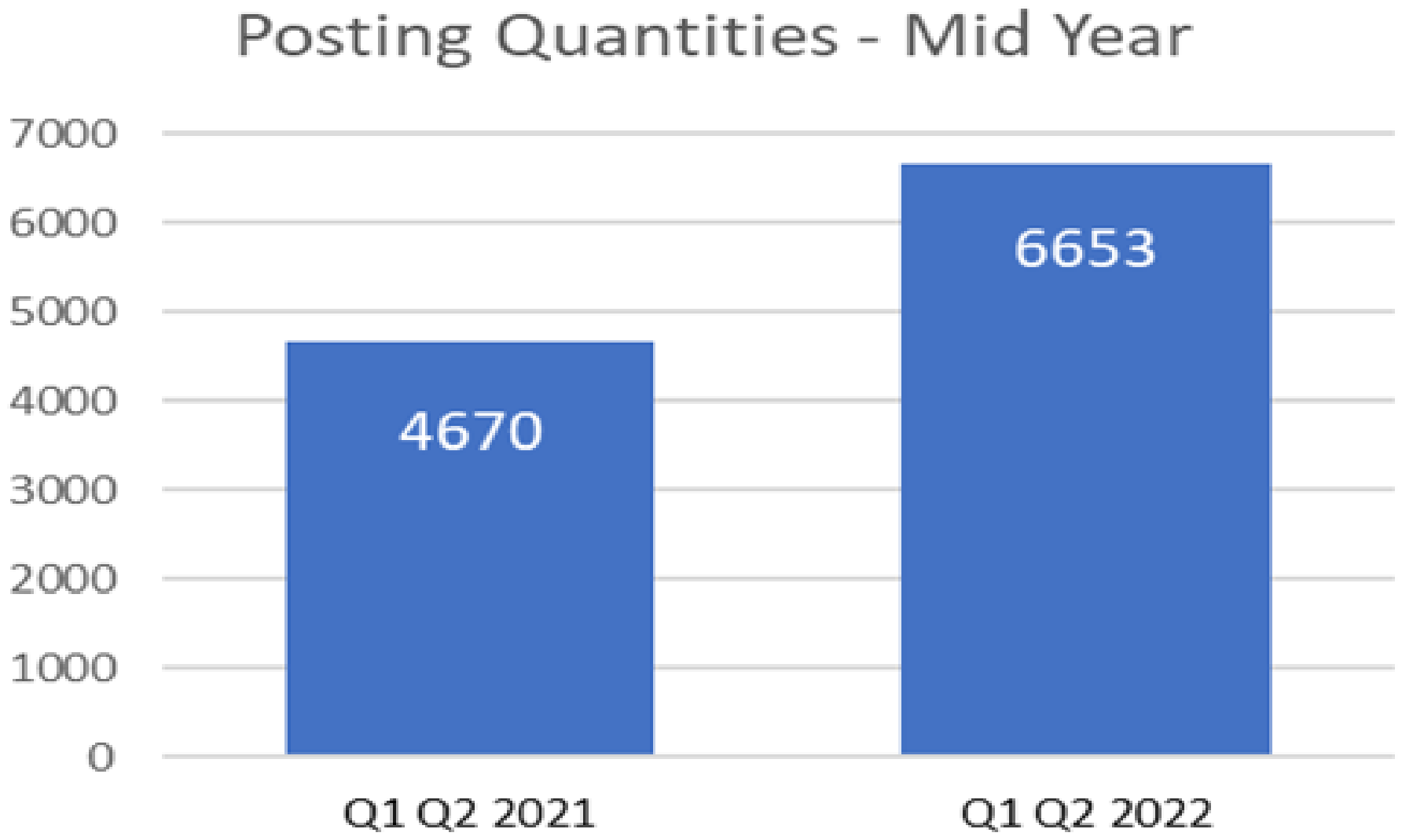
In 2023: several hundred images at higher resolution

Exponential growth in physician workload-Mayo Clinic -11 years

In 1999, a radiologist interpreting CT scans was required to interpret 2.8 images per minute. In 2010, that same number was over 19 images per minute.

https://www.radiologybusiness.com/topics/quality/feeling-overworked-rise-ct-mri-images-adds-radiologist-workload

Labor issues-MDs and DOs



A comparison of diagnostic imaging ordering patterns between advanced practice clinicians and primary care physicians following office-based evaluation and management visits

Danny R Hughes [1], Miao Jiang [1], Richard Duszak Jr [2]

Affiliations + expand

PMID: 25419763 DOI: 10.1001/jamainternmed.2014.6349

Abstract

Importance: Little is known about the use of diagnostic testing, such as medical imaging, by advanced practice clinicians (APCs), specifically, nurse practitioners and physician assistants.

Objective: To examine the use of diagnostic imaging ordered by APCs relative to that of primary care physicians (PCPs) following office-based encounters.

Design, setting, and participants: Using 2010-2011 Medicare claims for a 5% sample of beneficiaries, we compared diagnostic imaging ordering between APC and PCP episodes of care, controlling for geographic variation, patient demographics, and Charlson Comorbidity Index scores. Provider specialty codes were used to identify PCPs and APCs (general practice, family practice, or internal medicine for PCP; nurse practitioner or physician assistant for APC). Episodes were constructed using evaluation and management (E&M) office visits without any claims 30 days prior to the index visit and (1) no claims at all within the subsequent 30 days; (2) no claims within the subsequent 30 days other than a single imaging event; or (3) claims for any nonimaging services in that subsequent 30-day period.

Main outcomes and measures: The primary outcome was whether an imaging event followed a qualifying E&M visit.

Results: Advanced practice clinicians and PCPs ordered imaging in 2.8% and 1.9% episodes of care, respectively. In adjusted estimates and across all patient groups and imaging services, APCs were associated with more imaging than PCPs (odds ratio [OR], 1.34 [95% CI, 1.27-1.42]), ordering 0.3% more images per episode. Advanced practice clinicians were associated with increased radiography orders on both new (OR, 1.36 [95% CI, 1.13-1.66]) and established (OR

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West J Emerg Med. 2019 Jul; 20(4): 541–548.
Published online 2019 Jul 1. doi: 10.5811/westjem.2019.5.42465
PMCID: PMC6625685
PMID: 31316691

Resource Utilization in Non-Academic Emergency Departments with Advanced Practice Providers

Ali Aledhaim, NREMT-P, MS, DrPH,✉* Anne Walker, MD,† Roumen Vesselinov, PhD,‡ Jon Mark Hirshon, MD, PhD,* and Laura Pimentel, MD*

Author information · Article notes · Copyright and License information Disclaimer

Associated Data

Supplementary Materials

Abstract

Go to:

Introduction

Advanced practice providers (APP), including physicians' assistants and nurse practitioners, have been increasingly incorporated into emergency department (ED) staffing over the past decade. There is scant literature examining resource utilization and the cost benefit of having APPs in the ED. The objectives of this study were to compare resource utilization in EDs that use APPs in their staffing model with those that do not and to estimate costs associated with the utilized resources.

Methods

In this five-year retrospective secondary data analysis of the Emergency Department Benchmarking Alliance (EDBA), we compared resource utilization rates in EDs with and without APPs in non-academic EDs. Primary outcomes were hospital admission and use of computed tomography (CT), radiography, ultrasound, and magnetic resonance imaging (MRI). Costs were estimated using the 2014 physician fee schedule and inpatient payments from the Centers for Medicare and Medicaid Services. We measured outcomes as rates per 100 visits. Data were analyzed using a mixed linear model with repeated measures, adjusted for annual volume, patient acuity, and attending hours. We used the adjusted net difference to project utilization costs between the two groups per 1000 visits.

Results

Of the 1054 EDs included in this study, 79% employed APPs. Relative to EDs without APPs, EDs staffing APPs had higher resource utilization rates (use per 100 visits): 3.0 more admissions (95% confidence interval [CI], 2.0–4.1), 1.7 more CTs (95% CI, 0.2–3.1), 4.5 more radiographs (95% CI, 2.2–6.9), and 1.0 more ultrasound (95% CI, 0.3–1.7) but comparable MRI use 0.1 (95% CI, −0.2–0.3). Projected costs of these differences varied among the resource utilized. Compared to EDs without APPs, EDs with APPs were estimated to have 30.4 more admissions per 1000 visits, which could accrue $414,717 in utilization costs.

Conclusion

EDs staffing APPs were associated with modest increases in resource utilization as measured by admissions and imaging studies.

How do APPs change your risks now?

- Ordering volume vs. ordering accuracy
- Delay in appropriate care
- ”obvious” vs. “non-obvious” recommendations
- Stroke neurologist vs. PCP vs. non-physician

How do APPs change your risks now?

- Follow up and management

- Direct

Diagnostic Imaging Examinations Interpreted by Nurse Practitioners and Physician Assistants: A National and State-Level Medicare Claims Analysis

Valeria Makeeva[1], C. Matthew Hawkins[1], Andrew B. Rosenkrantz[2], Danny R. Hughes[3,4], Laura Chaves[3] and Richard Duszak, Jr.[1] Show less

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+ Affiliations:

Citation: American Journal of Roentgenology. 2019;213: 992-997. 10.2214/AJR.19.21306

ABSTRACT

Choose

OBJECTIVE. Nonphysician providers (NPPs) increasingly perform imaging-guided procedures, but their roles interpreting imaging have received little attention. We characterize diagnostic imaging services rendered by NPPs (i.e., nurse practitioners and physician assistants) in the Medicare population.

MATERIALS AND METHODS. Using 1994–2015 Medicare Physician/Supplier Procedure Summary Master Files, we identified all diagnostic imaging services, including those billed by NPPs, and categorized these by modality and body region. Using 2004–2015 Medicare Part B 5% Research Identifiable File Carrier Files, we separately assessed state-level variation in imaging services rendered by NPPs. Total and relative utilization rates were calculated annually.

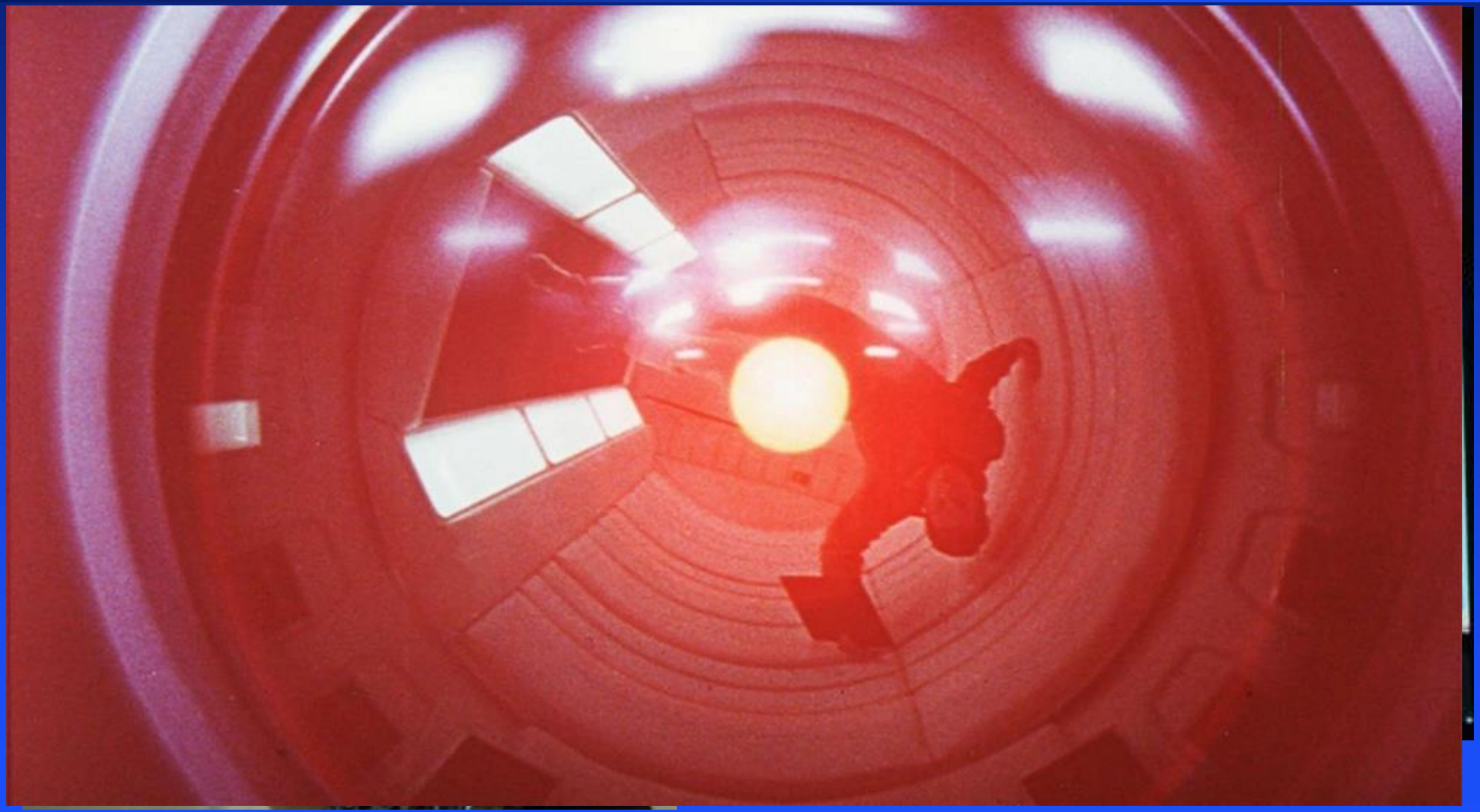
RESULTS. Between 1994 and 2015 nationally, diagnostic imaging services increased from 339,168 to 420,172 per 100,000 Medicare beneficiaries (an increase of 24%). During this same period, diagnostic imaging services rendered by NPPs increased 14,711% (from 36 to 5332 per 100,000 beneficiaries) but still represented only 0.01% and 1.27% of all imaging in 1994 and 2015, respectively. Across all years, radiography and fluoroscopy constituted most of the NPP-billed imaging services and remained constant over time (e.g., 94% of all services billed in 1994 and 2015), representing only 0.01% and 2.1% of all Medicare radiography and fluoroscopy services. However, absolute annual service counts for NPP-billed radiography and fluoroscopy services increased from 10,899 to 1,665,929 services between 1994 and 2015. NPP-billed imaging was most common in South Dakota (7987 services per 100,000 beneficiaries) and Alaska (6842 services per 100,000 beneficiaries) and was least common in Hawaii (231 services per 100,000 beneficiaries) and Pennsylvania (478 services per 100,000 beneficiaries).

CONCLUSION. Despite increasing roles of NPPs in health care across the United States, NPPs still rarely interpret diagnostic imaging studies. When they do, it is overwhelmingly radiography and fluoroscopy. Considerable state-to-state variation exists and may relate to local care patterns and scope-of-practice laws.

How could APPs change your risks in the future?

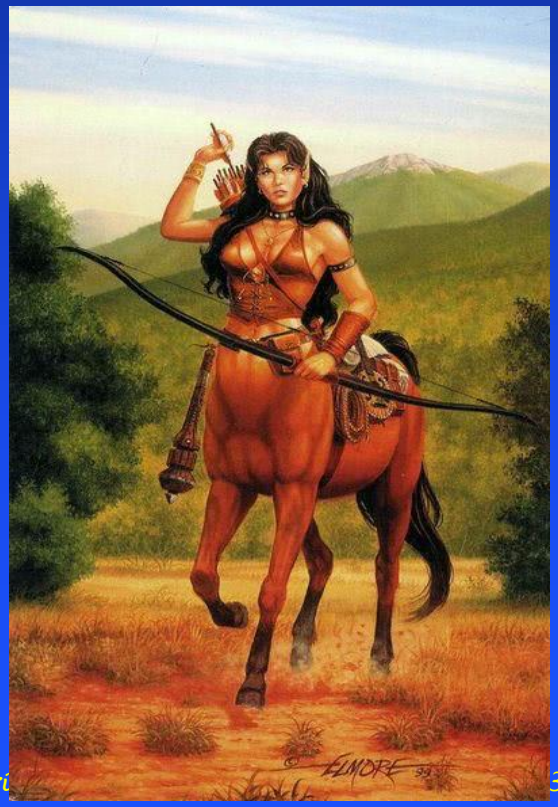
- Direct reading-working underneath you
- Direct reading as a colleague
- Direct reading as a competitor
- Standard of care- one tier or more than one
- Over 50 battlefronts in this conflict

AI and the radiology value chain



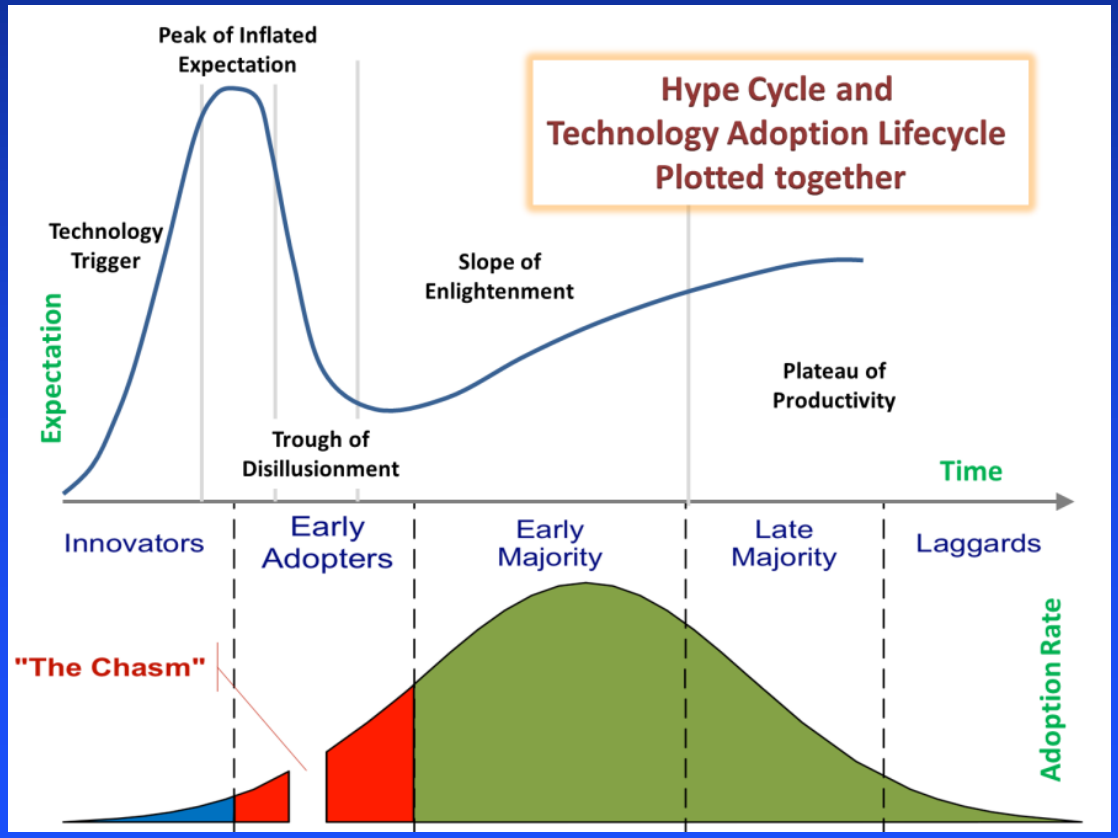
Centaurs in Myth and in Radiology

Augmented versus Irrelevant: I will become a ”centaur” radiologist



The Silicon Valley timing question. When should you invest in/adopt AI?

When to adopt and why? Don't believe every consulting curve that you see



If AI is the answer what is/are the question(s)

- Quality and Volume
- Cost of imaging performance and interpretation

If AI is the answer what is/are the question(s)

The Potential Impact of Artificial Intelligence on Medical Malpractice Claims from Diagnostic Errors in Radiology in New York

A review of past jury verdicts and settled claims also showed that focused future developments of AI in mammography and MRI modalities and in the breast and brain anatomy could reduce the number of large claims and therefore reduce average indemnity size. The introduction of AI could however also have the potential to increase average indemnity amounts if the number of megaverdicts increases which may be driven by juror sentiment when AI is involved in a medical malpractice case.

https://www.soa.org/4a7bfc/globalassets/assets/files/resources/research-report/2021/potential-impact-of-ai-on-medical-malpractice-claims.pdf

If AI is the answer: what is/are the question(s)?

Do we have enough radiologists now?

Can/should radiologists be replaced?

Who wants to replace us, who wants to augment us?

Are radiologists the "gold standard"

How good does AI have to be in order to to replace us?

…

AI and the radiology value chain

Image optimization
List ranking
Measurements
Physician and patient notification
Billing
Pre-dictation
Pulling from EMR and other sources

Autonomous reads

…

Stakeholder Issues-Radiologists

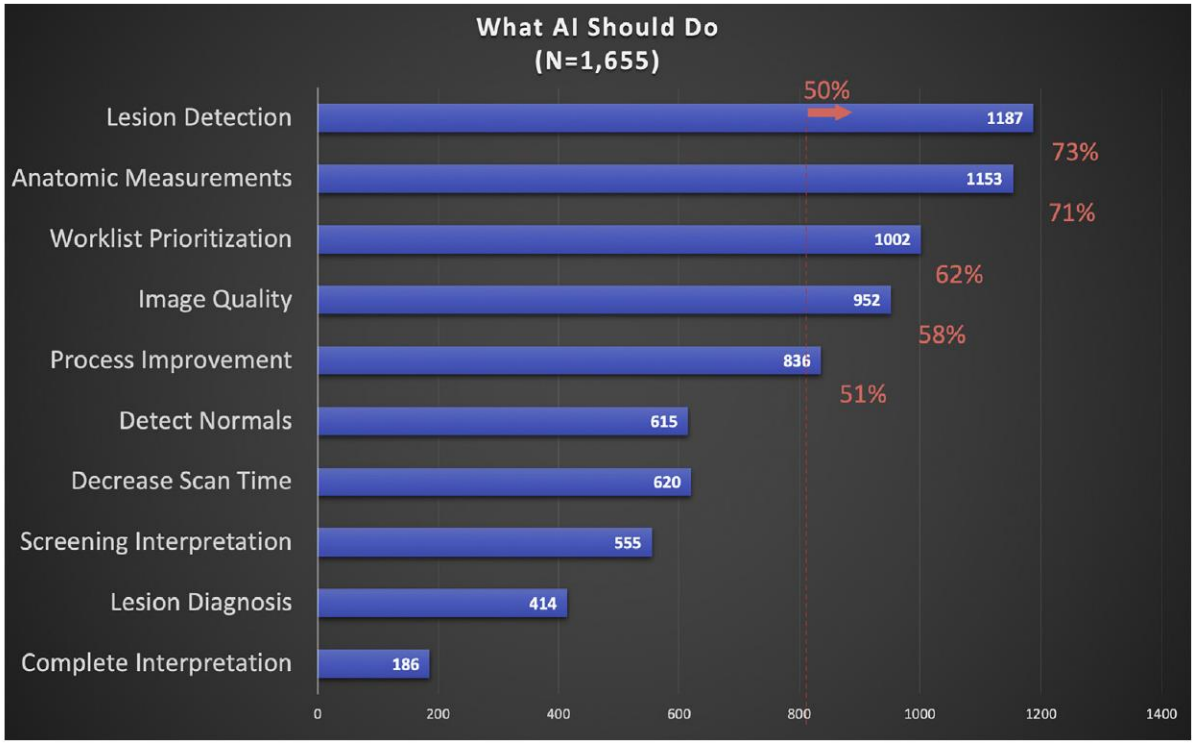


Fig. 1. Clinical needs for artificial intelligence tools. Respondents identified a number of clinical needs with over 50% selecting algorithms for assistance in image interpretation, anatomic measurements, prioritization, and quality and process improvement all selected by at least half of the respondents. Notably, complete autonomous interpretation of diagnostic or screening examinations was not considered a high priority for algorithm development.

J Am Coll Radiol 2021;18:1153-1159

What is the critical quality question for AI?

How good does AI have to be to become autonomous?

Article PDF Available

Are We All Less Risky and More Skillful than our Fellow Drivers?

February 1981 · Acta Psychologica 47(2):143-148
DOI:10.1016/0001-6918(81)90005-6

Authors:

Ola Svenson
Stockholm University

Download citation | Copy link

Citations (1,594) References (12) Figures (1)

Abstract and Figures

In this study subjects were asked about their competence as drivers in relation to a group of drivers. The results showed that a majority of subjects regarded themselves as more skillful and less risky than the average driver in each group respectively. This result was compared with similar recent findings in other fields. Finally, the consequences for planning and risk taking of seeing oneself as more competent than others were discussed briefly.

How good are humans at reading diagnostic imaging studies?

Fundamentals of Diagnostic Error in Imaging

Jason N. Itri, MD, PhD
Rafel R. Tappouni, MD
Rachel O. McEachern, MD
Arthur J. Pesch, MD
Sohil H. Patel, MD

Abbreviations: EMR = electronic medical record, HCC = hepatocellular carcinoma, MCC = missed case conference, PACS = picture archiving and communication system, PLC = peer learning conference

RadioGraphics 2018; 38:1845–1865

https://doi.org/10.1148/rg.2018180021

Content Code: SQ

From the Department of Radiology, Wake Forest Baptist Medical Center, Medical Center Blvd, Winston-Salem, NC 27157-1088 (J.N.I., R.R.T.); and Department of Radiology and Medical Imaging, University of Virginia Health System, Charlottesville, Va (R.O.M., A.J.P., S.H.P.). Received February 16, 2018; accepted March 28. For this journal-based SA-CME activity, the authors, editor, and reviewers have disclosed no relevant relationships. **Address correspondence to** J.N.I. (e-mail: *drjitri@gmail.com*).

Imaging plays a pivotal role in the diagnostic process for many patients. With estimates of average diagnostic error rates ranging from 3% to 5%, there are approximately 40 million diagnostic errors involving imaging annually worldwide. The potential to improve diagnostic performance and reduce patient harm by identifying and learning from these errors is substantial. Yet these relatively high diagnostic error rates have persisted in our field despite decades of research and interventions. It may often seem as if diagnostic errors in radiology occur in a haphazard fashion. However, diagnostic problem solving in radiology is not a mysterious black box, and diagnostic errors are not random occurrences. Rather, diagnostic errors are predictable events with readily identifiable contributing factors, many of which are driven by how we think or related to the external environment. These contributing factors lead to both perceptual and interpretive errors. Identifying contributing factors is one of the keys to developing interventions that reduce or mitigate diagnostic errors. Developing a comprehensive process to identify diagnostic errors, analyze them to discover contributing factors and biases, and develop interventions based on the contributing factors is fundamental to learning from diagnostic error. Coupled with effective peer learning practices, supportive leadership, and a culture of quality, this process can unquestionably result in fewer diagnostic errors, improved patient outcomes, and increased satisfaction for

Evidence for quality and safety in workload volume-Radiology

Doubling the reading speed for abdominal-pelvic CT studies led to 166% increase in major misses

ELSEVIER

Journal of the American College of Radiology

Volume 12, Issue 7, July 2015, Pages 683-688

Clinical practice management

Original article

The Effect of Faster Reporting Speed for Imaging Studies on the Number of Misses and Interpretation Errors: A Pilot Study

Evgeniya Sokolovskaya DO, MD, Tejas Shinde MD, Richard B. Ruchman MD, Andrew J. Kwak MD, Stanley Lu MD, Yasmeen K. Shariff MD, Ernest F. Wiggins MD, Leizle Talangbayan MD

Evidence for quality and safety in workload volume-Radiology

Not surprisingly, fatigue worsens diagnostic performance, slowing of scan patterns, and increased fixation

ELSEVIER

Journal of the American College of Radiology

Volume 15, Issue 12, December 2018, Pages 1709-1716

Original article

Clinical practice management

The Effects of Fatigue From Overnight Shifts on Radiology Search Patterns and Diagnostic Performance

Tarek N. Hanna MD [a], Matthew E. Zygmont MD [a], Ryan Peterson MD [a], David Theriot MD [a], Haris Shekhani MD [a], Jamlik-Omari Johnson MD [a], Elizabeth A. Krupinski PhD [a]

Evidence for quality and safety in workload volume-Radiology

A review of almost 3,000,000 examinations showed that discrepancies correlated with higher volumes and longer shifts (peak after 10 hours)

Original Research
Health Policy and Practice

Free Access

Effect of Shift, Schedule, and Volume on Interpretive Accuracy: A Retrospective Analysis of 2.9 Million Radiologic Examinations

Tarek N. Hanna* ✉, Christine Lamoureux*, Elizabeth A. Krupinski, Scott Weber, Jamlik-Omari Johnson

* T.N.H. and C.L. contributed equally to this work.

Author Affiliations

Published Online: Nov 20 2017 | https://doi.org/10.1148/radiol.2017170555

Evidence for quality and safety in workload volume-Neuroradiology

Significant errors in neuro increase with:
Increased speed of reading
Later portion of the shift
Lower experience (< 5 years as an attending)

Risk Factors for Perceptual-versus-Interpretative Errors in Diagnostic Neuroradiology

S.H. Patel, C.L. Stanton, S.G. Miller, J.T. Patrie, J.N. Itri and T.M. Shepherd

American Journal of Neuroradiology August 2019, 40 (8) 1252-1256; DOI: https://doi.org/10.3174/ajnr.A6125

The increase in errors is noticeable with an increase from 5 to 6 cases an hour…

The Philadelphia Question

AI failure factors in malpractice

Limitations of the algorithm: sensitivity-miss/specificity-mis-diagnosis

Installation

Appropriate data sets

Data drift

Upgrades, re-validation

Idiosyncratic errors

Malpractice Targets with AI

Who can we sue for malpractice?

The AI manufacturer?
The hospital that buys the software?
The radiologist(s) who are in the department where it is used?

Types of liability

Vendor liability-depends on FDA approval and enforcement of Federal pre-emption

Current law favors AI as a tool-putting the physician (tool user) at liability risk rather than an autonomous entity

AI can be an assistant (like an APP) working with supervision

AI can be given "personhood" and then be sued

Enterprise liability- if your hospital administrators decide that autonomous AI is cheaper than radiologists then that is one potential risk focus

Malpractice Questions

Will the AI's interpretations be saved if they conflict with the radiologist of record

Will plaintiff's attorneys use AI an an expert witness?

Will liability insurance carriers require the use of AI?

Do patients need to know and/or sign informed consent if AI reads their studies?

In a WSJ article, Kissinger argued for "watermarking" AI output

-Kissinger et al. WSJ "ChatGPT Heralds an Intellectual Revolution" Feb 24, 2023

AI threats and opportunities

CEO Relieved AI Can Never Replace Him If He Already Contributes Nothing To Company

Thanks!

- fjlexamd@icloud.com

If AI is the answer what is/are the question(s)

- Quality
- Cost of imaging performance and interpretation

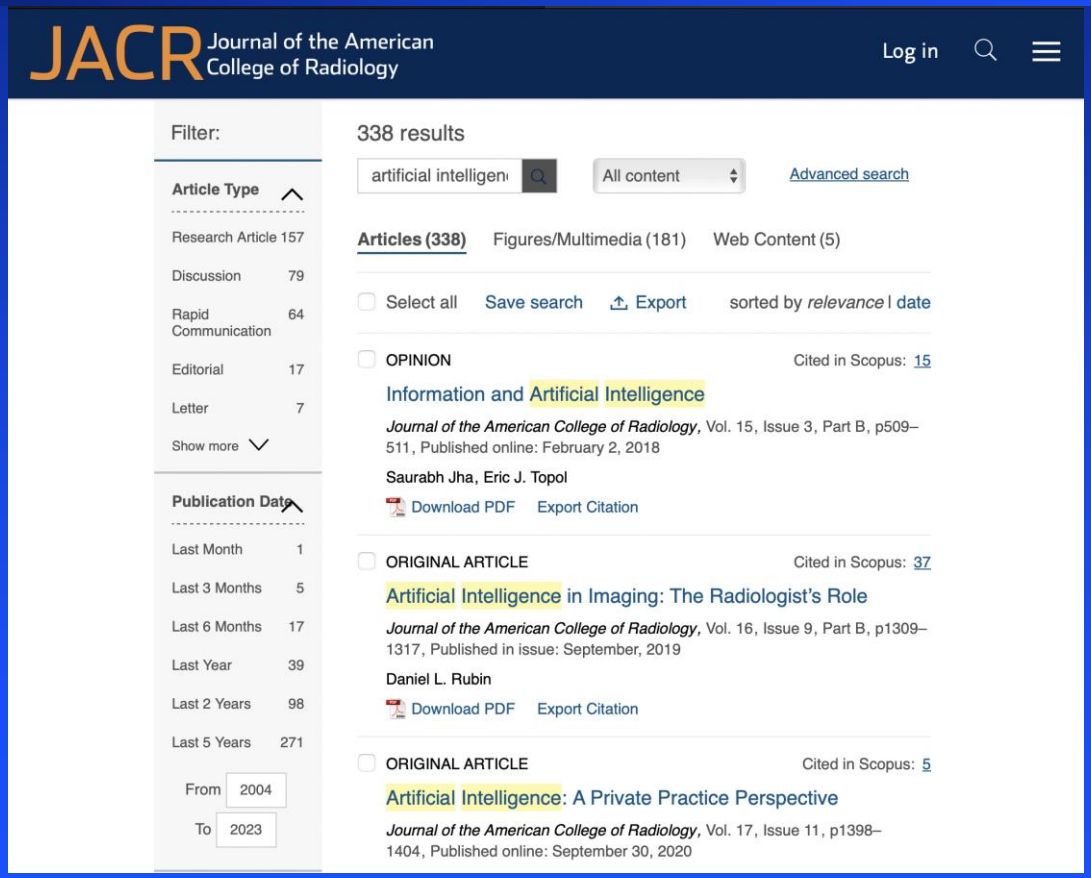
"Here's to the crazy ones, the misfits, the rebels, the troublemakers, the round pegs in the square holes ... …They push the human race forward, and while some may see them as the crazy ones, we see genius, **because the people who are crazy enough to think that they can change the world, are the ones who do."**

AI- one of the hottest topics in medicine

FDA has approved over 500 medical AI algorithms.

Almost 400 of those apply to radiology

AI- one of the hottest topics in medicine-particularly radiology



AI- one of the hottest topics in radiology.

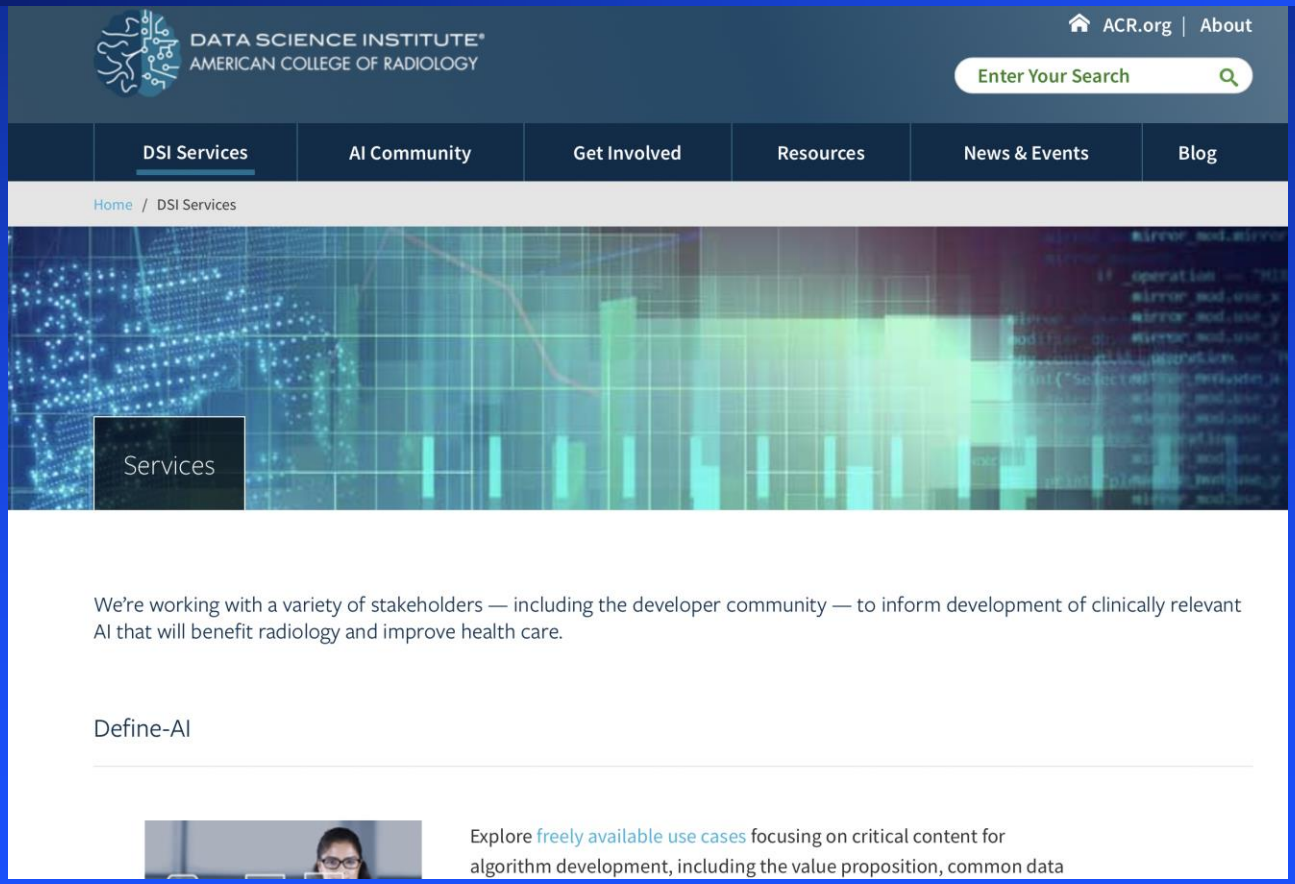
By 2019 already over 200 companies presenting at RSNA

By 2021, over 80 FDA approved algorithms and 30% of practices were using some form of AI

J Am Coll Radiol 2021;18:1153-1159

By 2023, approximately 400 products in queue for approval in Canada

AI- one of the hottest topics in the ACR



ORIGINAL ARTICLE HEALTH SERVICES RESEARCH AND POLICY | VOLUME 20, ISSUE 2, P134-145, FEBRUARY 2023

PDF [1 MB]

The Low Rate of Adherence to Checklist for Artificial Intelligence in Medical Imaging Criteria Among Published Prostate MRI Artificial Intelligence Algorithms

Mason J. Belue, BS • Stephanie A. Harmon, PhD • Nathan S. Lay, PhD • ... Tim E. Phelps, PhD • Peter L. Choyke, MD • Baris Turkbey, MD • Show all authors

Published: July 31, 2022 • DOI: https://doi.org/10.1016/j.jacr.2022.05.022 • Check for updates

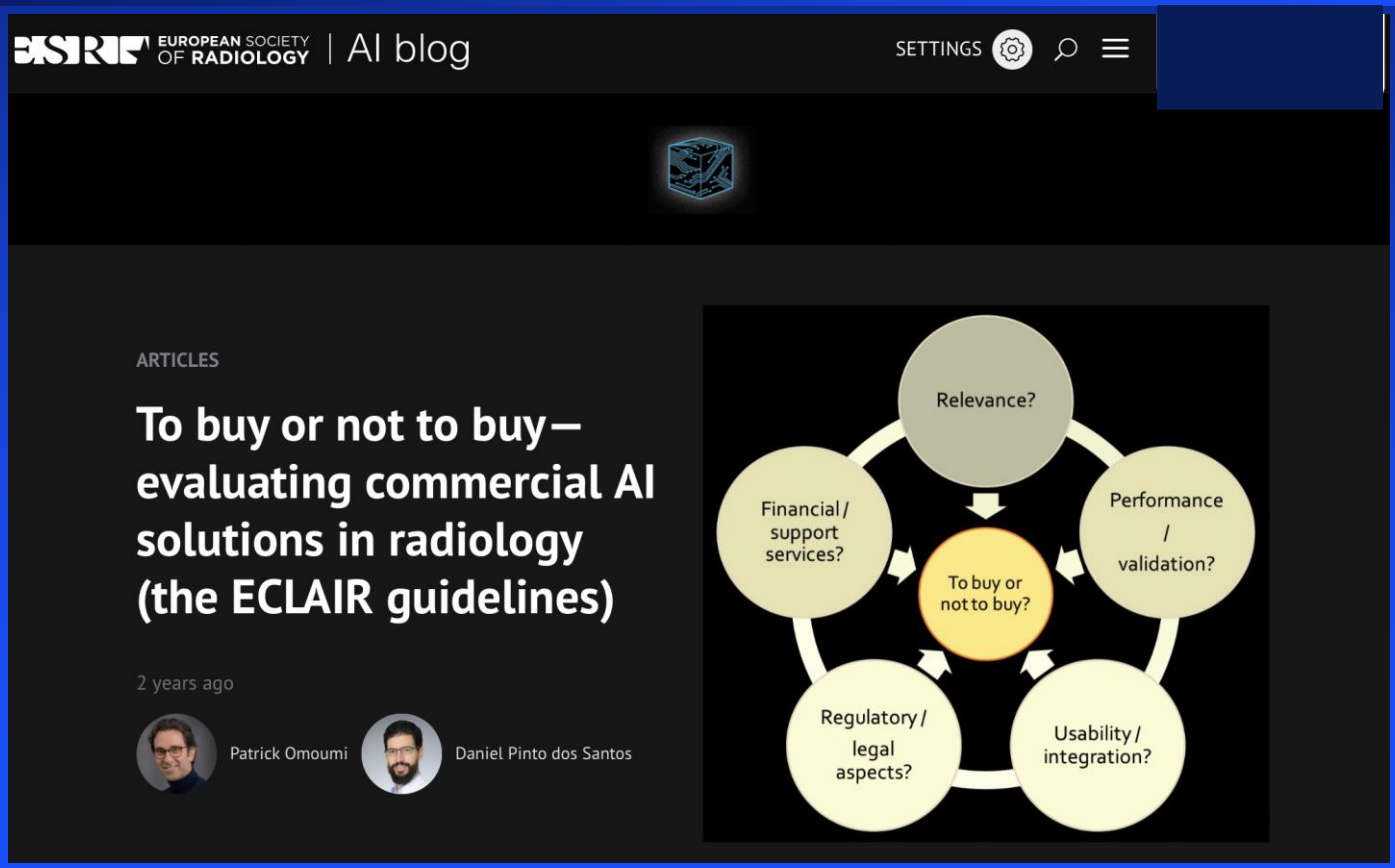
nd Methods

Abstract

Objective

To determine the rigor, generalizability, and reproducibility of published classification and detection artificial intelligence (AI) models for prostate cancer (PCa) on MRI using the Checklist for Artificial Intelligence in Medical Imaging (CLAIM) guidelines, a 42-item checklist that is considered a measure of best practice for presenting and reviewing medical imaging AI research.

AI- one of the hottest topics in EU radiology



AI and the radiology value chain

Pulling in other types of information

Display and cross comparison of sequences

Safety and quality metrics

AI peer review, feedback and education

AI and the radiology value chain

Physician and patient notification
-report conversions

Billing

Pre-dictation and autonomous reads

Positive side effects and agendas-

…

If AI is the answer: what is/are the question(s)?

Do we have enough radiologists now?

Can/should radiologists be replaced?

Who wants to replace us, who wants to augment us?

Are radiologists the "gold standard"

How good does AI have to be in order to to replace us?

…

How hard is it read a head CT?

- One way to answer this is to ask how many things you need to check
- Another way is to pull out some textbooks: neurology, trauma, ID, inflammatory diseases, etc. and ask how many pathological entities affect the head and neck

Current workforce issues- exponential workload growth

1. Work RVU expectations keep growing
2. Definition of a head CT has changed by over an order of magnitude
3. Speed, intensity and timing of cases have all increased the stress in the workplace for radiologists
4. An aging population means more imaging
5. NPs-Not(Never) Physicians order more tests than physicians

Going the wrong way in the 21st century…

European Journal of Radiology xxx (xxxx) xxx

Contents lists available at ScienceDirect

European Journal of Radiology

journal homepage: www.elsevier.com/locate/ejrad

Burnout and work-work imbalance in radiology- wicked problems on a global scale. A baseline pre-COVID-19 survey of US neuroradiologists compared to international radiologists and adjacent staff

James Y. Chen [a,b], Srinivasan Vedantham [c], Frank J. Lexa [d,*]

[a] San Diego Veterans Administration Health System, La Jolla, CA, USA
[b] UC San Diego Health System, San Diego, CA, USA
[c] University of Arizona, Tucson, AZ, USA
[d] University of Pittsburgh and UPMC International, Pittsburgh, PA USA

Serious Practice and Specialty Issues Are Developing through Cut-Backs of Sustaining Activities

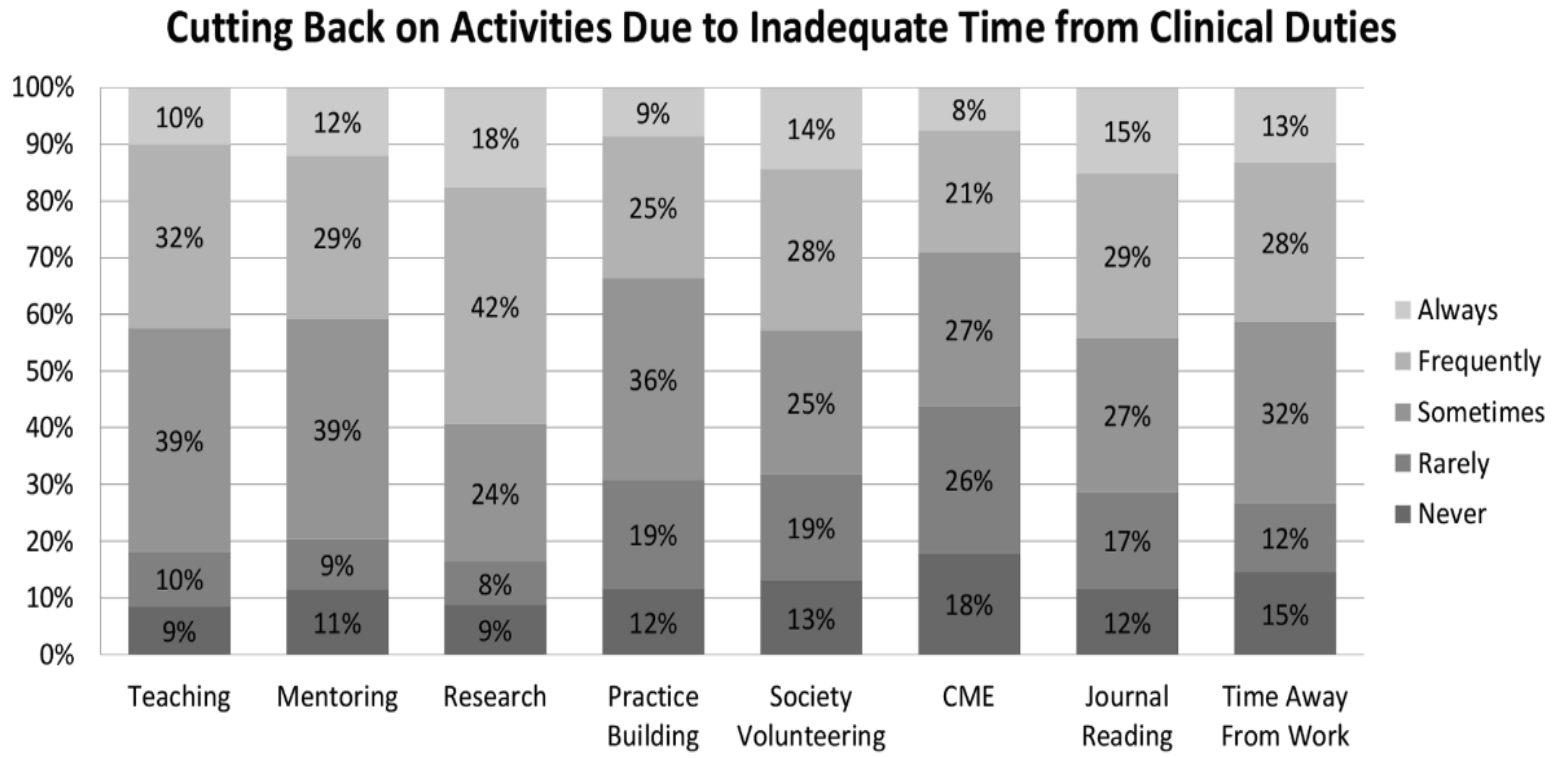


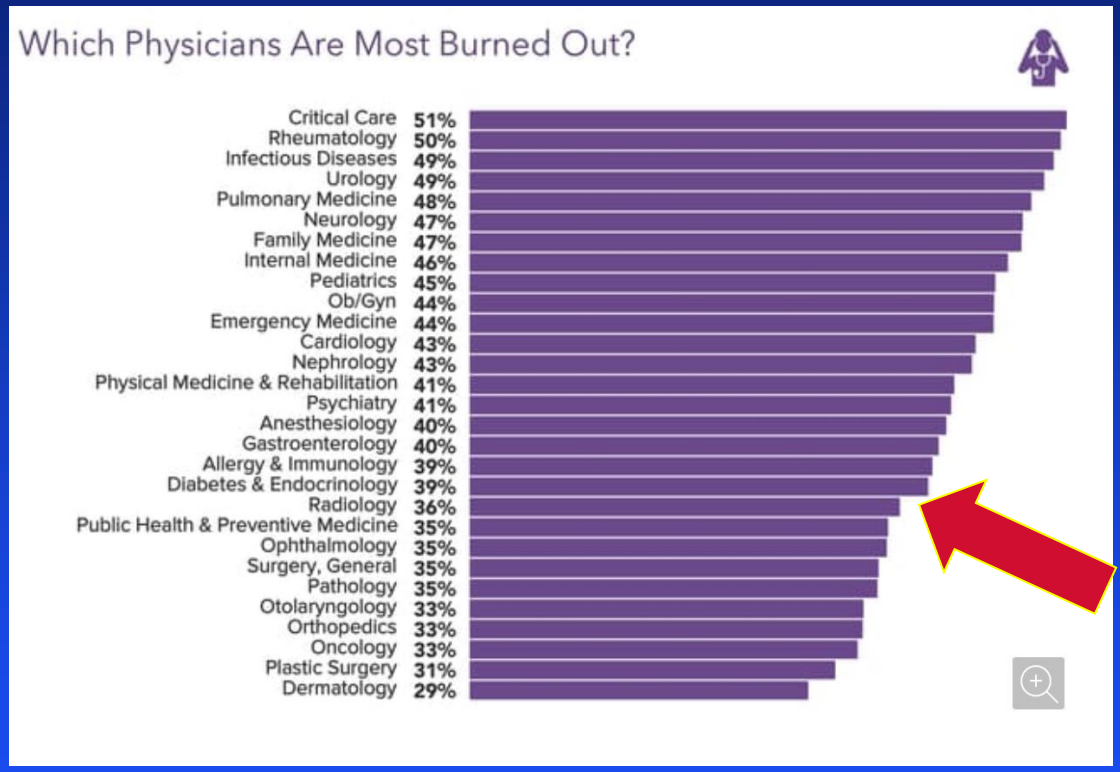
Fig. 1. The percentage of respondents reporting cutting back time spent performing various non-clinical duties who consider those duties part of their job description. This specifically excludes respondents who answered, "Not Applicable" to those duties.

Neuroradiology July 2017, 38 (7) 1284-1291; DOI: https://doi.org/10.3174/ajnr.A5215

Unhappiness is a big issue for us. Likert scale by specialty:

Peckham, Carol Physician Burnout: It Just Keeps Getting Worse. Medscape. Jan 26, 2015, accessed on May 9, 2016 at http://www.medscape.com/viewarticle/838437_2

Burnout is prevalent and increasing in US medicine



Peckham, Carol Physician Burnout: It Just Keeps Getting Worse. Medscape. Jan 26, 2015, accessed on May 9, 2016 at http://www.medscape.com/viewarticle/838437_2

Burnout in the radiological

- A M … aled over 40 h … gine, but only … the title
- A P … revealed ove … raphers and … t focused on … n recent yea …

Burnout in radiology is a global issue, although a larger proportion of publications originate in the United States:

- A study from Poland showed high burnout rates in 37.1% of radiologists [4]
- A study from Hungary showed higher responses by radiographers compared to the average population in emotional depletion, depersonalization and personal efficiency [5].
- Ganeshan et al. surveyed the full members of the Association of University Radiologists (US) in late 2018 using the abbreviated Maslach Inventory and found that 79% had at least one symptom of burnout, with 29% meeting all three criteria burnout: emotional exhaustion, depersonalization and low personal accomplishment [6].
- Burnout can also be seen at the trainee level. A study from 2014 in the USA showed increased burnout in medical trainees [7].
- In a study from Saudi Arabia, one quarter of residents showed high burnout rates and over half had emotional exhaustion [8].
- Looking at academic chairs of radiology in the United States revealed a lower, but still significant rate of burnout with 5% of those surveyed meeting all three criteria for burnout [9]

More recently a survey of US academic radiologists revealed an incidence of burnout of 37% with intention to leave of 33% and sleep related impairment of 45%. The incidence of burnout was higher in women than in men [10]. Practice leaders in the United States are also very concerned about burnout and related issues. A survey showed that over half −55% considered burnout a very significant problem with an additional 22% considering it a significant problem [11]

http://www.jacr.org/action/d … searchType=quick&se … Site&startPage=1#navigation

Labor issues-MDs and DOs

Rise in cases and appropriateness not well addressed.

No significant planned increases in US residency slots

Some help from immigration

Substantial number of “early” retirements

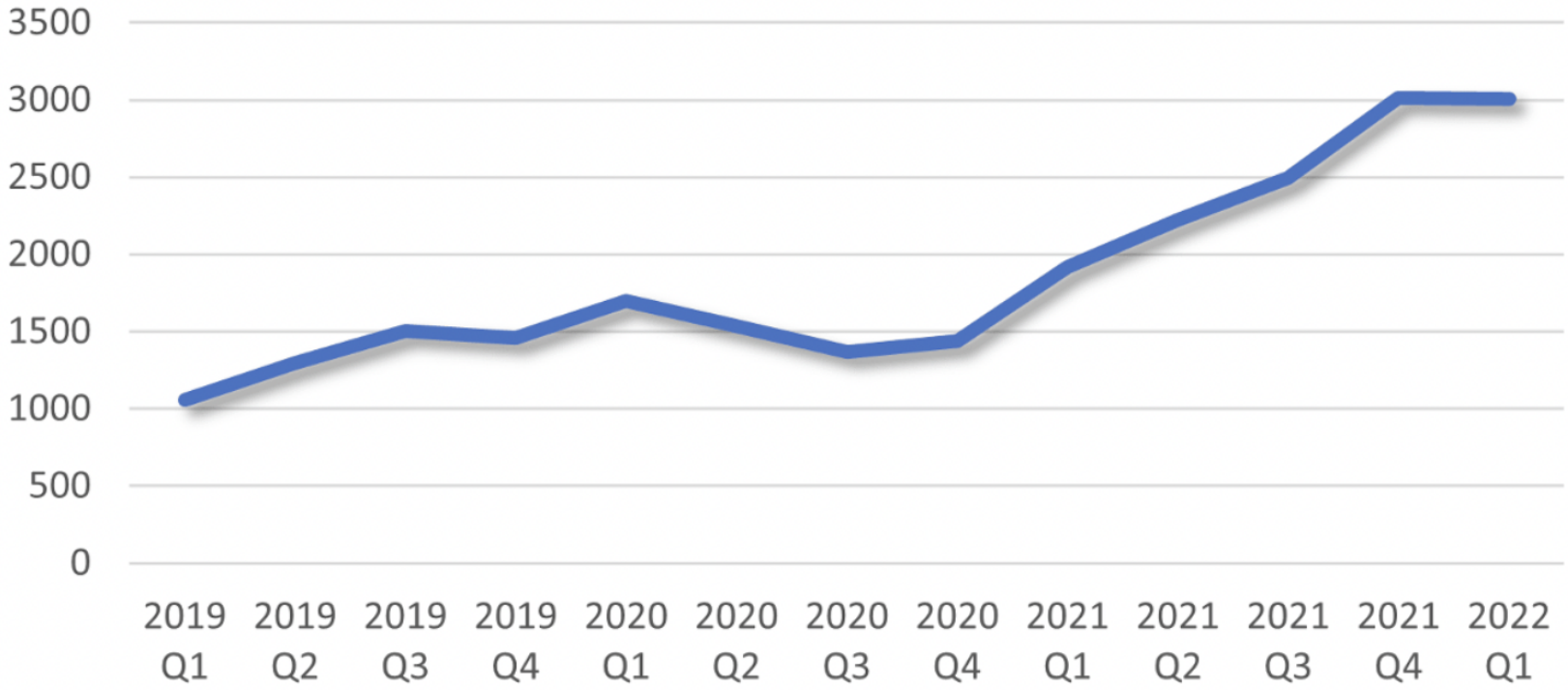
Large number of older radiologists who do not want to work full time, take regular call, etc.

Burnout is not being addressed.

Some Good News?- ACR job postings

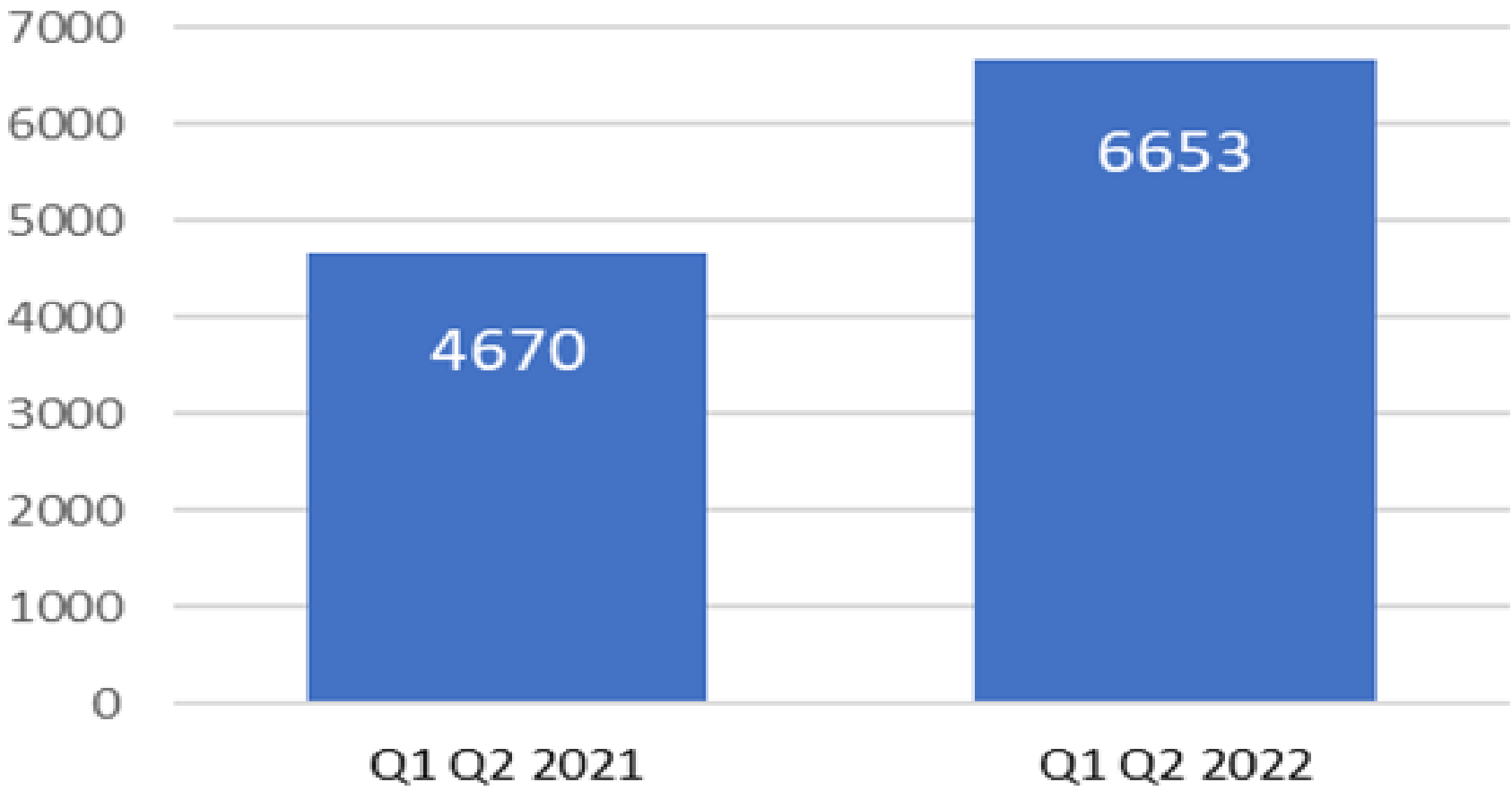
Figure 1.1

New Radiology Job Postings
ACR Job Board, By Quarter



Source: vRad analysis of ACR job board data, 2019-2022

ACR job board



How good are humans at reading diagnostic imaging studies?

Fundamentals of Diagnostic Error in Imaging

Jason N. Itri, MD, PhD
Rafel R. Tappouni, MD
Rachel O. McEachern, MD
Arthur J. Pesch, MD
Sohil H. Patel, MD

Abbreviations: EMR = electronic medical record, HCC = hepatocellular carcinoma, MCC = missed case conference, PACS = picture archiving and communication system, PLC = peer learning conference

RadioGraphics 2018; 38:1845–1865

https://doi.org/10.1148/rg.2018180021

Content Code: SQ

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Imaging plays a pivotal role in the diagnostic process for many patients. With estimates of average diagnostic error rates ranging from 3% to 5%, there are approximately 40 million diagnostic errors involving imaging annually worldwide. The potential to improve diagnostic performance and reduce patient harm by identifying and learning from these errors is substantial. Yet these relatively high diagnostic error rates have persisted in our field despite decades of research and interventions. It may often seem as if diagnostic errors in radiology occur in a haphazard fashion. However, diagnostic problem solving in radiology is not a mysterious black box, and diagnostic errors are not random occurrences. Rather, diagnostic errors are predictable events with readily identifiable contributing factors, many of which are driven by how we think or related to the external environment. These contributing factors lead to both perceptual and interpretive errors. Identifying contributing factors is one of the keys to developing interventions that reduce or mitigate diagnostic errors. Developing a comprehensive process to identify diagnostic errors, analyze them to discover contributing factors and biases, and develop interventions based on the contributing factors is fundamental to learning from diagnostic error. Coupled with effective peer learning practices, supportive leadership, and a culture of quality, this process can unquestionably result in fewer diagnostic errors, improved patient outcomes, and increased satisfaction for

Evidence for quality and safety in workload volume-Radiology

Doubling the reading speed for abdominal-pelvic CT studies led to 166% increase in major misses

ELSEVIER

Journal of the American College of Radiology

Volume 12, Issue 7, July 2015, Pages 683-688

Clinical practice management

Original article

The Effect of Faster Reporting Speed for Imaging Studies on the Number of Misses and Interpretation Errors: A Pilot Study

Evgeniya Sokolovskaya DO, MD, Tejas Shinde MD, Richard B. Ruchman MD, Andrew J. Kwak MD, Stanley Lu MD, Yasmeen K. Shariff MD, Ernest F. Wiggins MD, Leizle Talangbayan MD

Evidence for quality and safety in workload volume-Radiology

Not surprisingly, fatigue worsens diagnostic performance, slowing of scan patterns, and increased fixation

ELSEVIER

Journal of the American College of Radiology

Volume 15, Issue 12, December 2018, Pages 1709-1716

Original article

Clinical practice management

The Effects of Fatigue From Overnight Shifts on Radiology Search Patterns and Diagnostic Performance

Tarek N. Hanna MD [a], Matthew E. Zygmont MD [a], Ryan Peterson MD [a], David Theriot MD [a], Haris Shekhani MD [a], Jamlik-Omari Johnson MD [a], Elizabeth A. Krupinski PhD [a]

Evidence for quality and safety in workload volume-Radiology

A review of almost 3,000,000 examinations showed that discrepancies correlated with higher volumes and longer shifts (peak after 10 hours)

Original Research
Health Policy and Practice

Free Access

Effect of Shift, Schedule, and Volume on Interpretive Accuracy: A Retrospective Analysis of 2.9 Million Radiologic Examinations

Tarek N. Hanna* ✉, Christine Lamoureux*, Elizabeth A. Krupinski, Scott Weber, Jamlik-Omari Johnson

* T.N.H. and C.L. contributed equally to this work.

Author Affiliations

Published Online: Nov 20 2017 | https://doi.org/10.1148/radiol.2017170555

Evidence for quality and safety in workload volume-Neuroradiology

Significant errors in neuro increase with:
Increased speed of reading
Later portion of the shift
Lower experience (< 5 years as an attending)

Risk Factors for Perceptual-versus-Interpretative Errors in Diagnostic Neuroradiology

S.H. Patel, C.L. Stanton, S.G. Miller, J.T. Patrie, J.N. Itri and T.M. Shepherd

American Journal of Neuroradiology August 2019, 40 (8) 1252-1256; DOI: https://doi.org/10.3174/ajnr.A6125

The increase in errors is noticeable with an increase from 5 to 6 cases an hour…

What are the important questions if you wanted to invest in AI?

Who is the customer?

Who will buy this? Why will they buy it? How much will they pay and why?

Who will use it and how? Will radiologists read each case, only ones that are flagged with path, just the ones with "hard path"?

What are the important questions if you wanted to invest in AI?

How good does AI have to be to become autonomous?

Article PDF Available

Are We All Less Risky and More Skillful than our Fellow Drivers?

February 1981 · Acta Psychologica 47(2):143-148

DOI:10.1016/0001-6918(81)90005-6

Authors:

Ola Svenson
Stockholm University

Download citation | Copy link

Citations (1,594) References (12) Figures (1)

Abstract and Figures

In this study subjects were asked about their competence as drivers in relation to a group of drivers. The results showed that a majority of subjects regarded themselves as more skillful and less risky than the average driver in each group respectively. This result was compared with similar recent findings in other fields. Finally, the consequences for planning and risk taking of seeing oneself as more competent than others were discussed briefly.

Stakeholder Issues-Radiologists

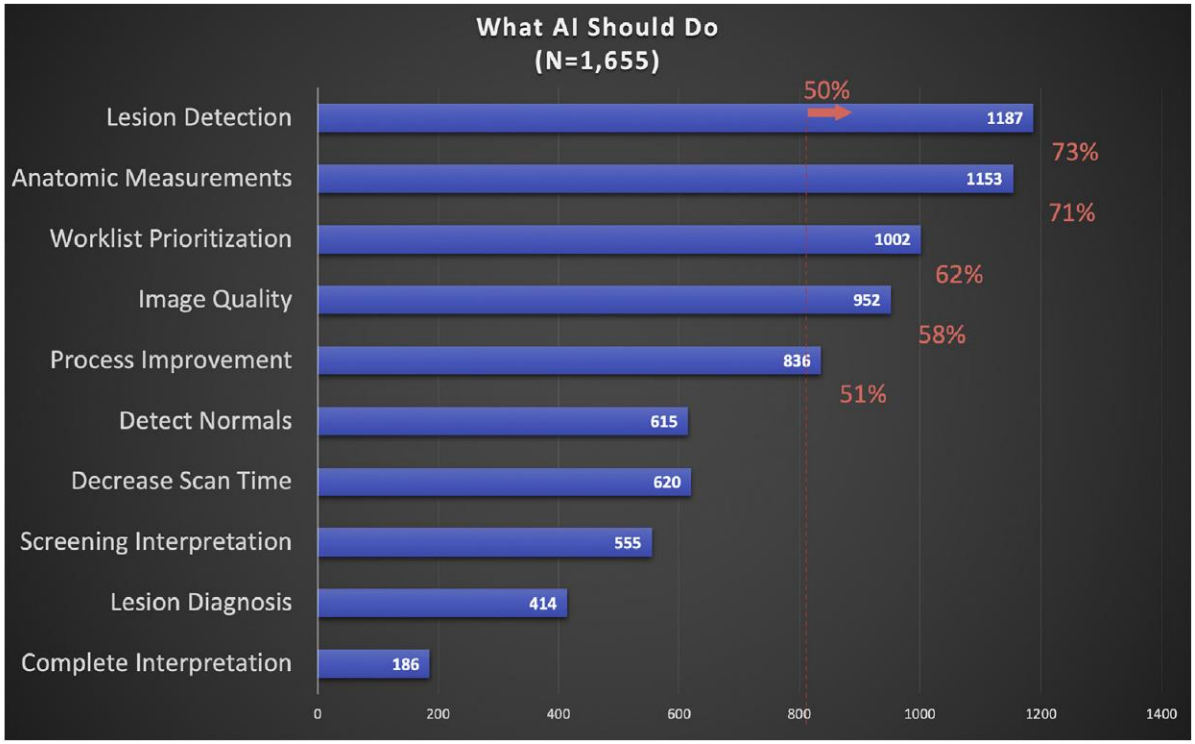


Fig. 1. Clinical needs for artificial intelligence tools. Respondents identified a number of clinical needs with over 50% selecting algorithms for assistance in image interpretation, anatomic measurements, prioritization, and quality and process improvement all selected by at least half of the respondents. Notably, complete autonomous interpretation of diagnostic or screening examinations was not considered a high priority for algorithm development.

J Am Coll Radiol 2021;18:1153-1159

Stakeholder Issues-Patients

Artificial Intelligence in Screening Mammography: A Population Survey of Women's Preferences

Yfke P. Ongena, PhD[a], Derya Yakar, MD, PhD[b], Marieke Haan, PhD[c], Thomas C. Kwee, MD, PhD[d]

Abstract

Objective: To investigate the general population's view on the use of artificial intelligence (AI) for the diagnostic interpretation of screening mammograms.

Methods: Dutch women aged 16 to 75 years were surveyed using the Longitudinal Internet Studies for the Social sciences panel, representative for the Dutch population. Attitude toward AI in mammography screening was measured by means of five items: necessity of a human check; AI as a selector for second reading; AI as a second reader; developer is responsible for error; and radiologist is responsible for error.

Results: Of the 922 participants included, 77.8% agreed with the necessity of a human check, whereas the item AI as a selector for a second reading was more heterogeneously answered, with 41.7% disagreement, 31.5% agreement, and 26.9% responding with "neither agree nor disagree." The item AI as a second reader was mostly responded with "neither agree nor disagree" (37.1%) and "agree" (37.6%), whereas the two last items on developer's and radiologist' responsibilities were mostly answered with "neither agree nor disagree" (44.6% and 39.2%, respectively).

Discussion: Despite recent breakthroughs in the diagnostic performance of AI algorithms for the interpretation of screening mammograms, the general population currently does not support a fully independent use of such systems without involving a radiologist. The combination of a radiologist as a first reader and an AI system as a second reader in a breast cancer screening program finds most support at present. Accountability in case of AI-related diagnostic errors in screening mammography is still an unresolved conundrum.

Key Words: Artificial intelligence, breast cancer, mammography, mass screening, surveys and questionnaires

J Am Coll Radiol 2021;18:79-86.

Disruptive Technologies

Disruptive Technology-Definition

1. Disruptive innovation- *Disruptive Technologies: Catching the Wave- Clayton Christensen and Joseph Bower. Harvard Business Review 1995. Later book: The Innovator's Dilemma*

2. *Business model of innovation that allows lower cost (often lower quality) to extend a market, in the process undermining current users.*

3. *Examples-*
    1. *Japanese motorcycles,*
    2. *Disk drive systems for computers*
    3. *Imaging systems for non radiologists*

AI

The Philadelphia Question

Wicked Questions

Who can we sue for malpractice?

The AI manufacturer?
The hospital that buys the software?
The radiologist(s) who are the department where it is used?

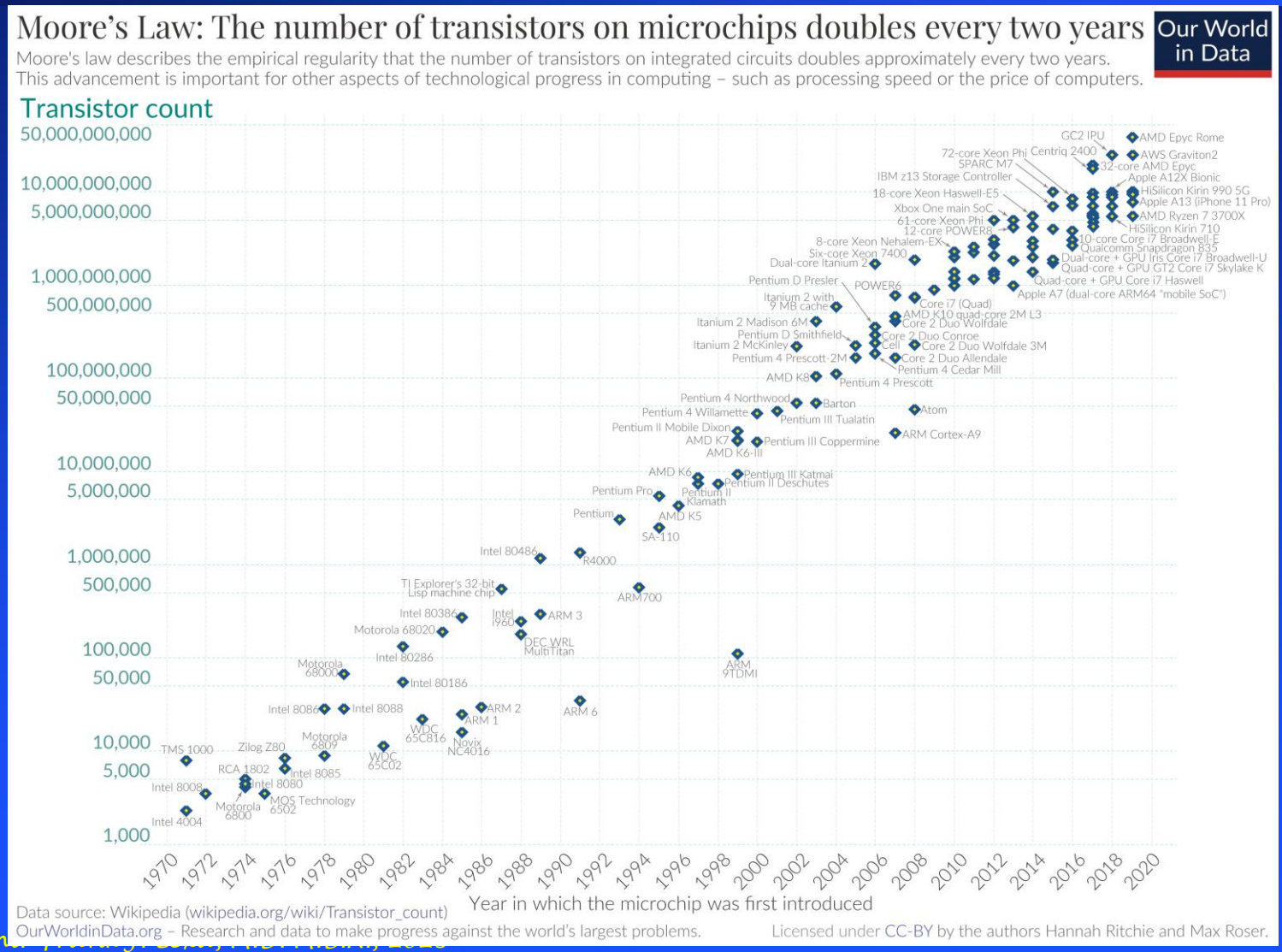
Will the AI's interpretations be saved if they conflict with the radiologist of record

Do patients need to know and/or sign informed consent if AI reads their studies?

In a WSJ article, Kissinger argued for "watermarking" AI output

-Kissinger et al. WSJ "ChatGPT Heralds an Intellectual Revolution" Feb 24, 2023

The Silicon Valley Questions



The Silicon Valley Questions

Moore's law involved doubling every year and half with limits as transistor size can't become infinitely small

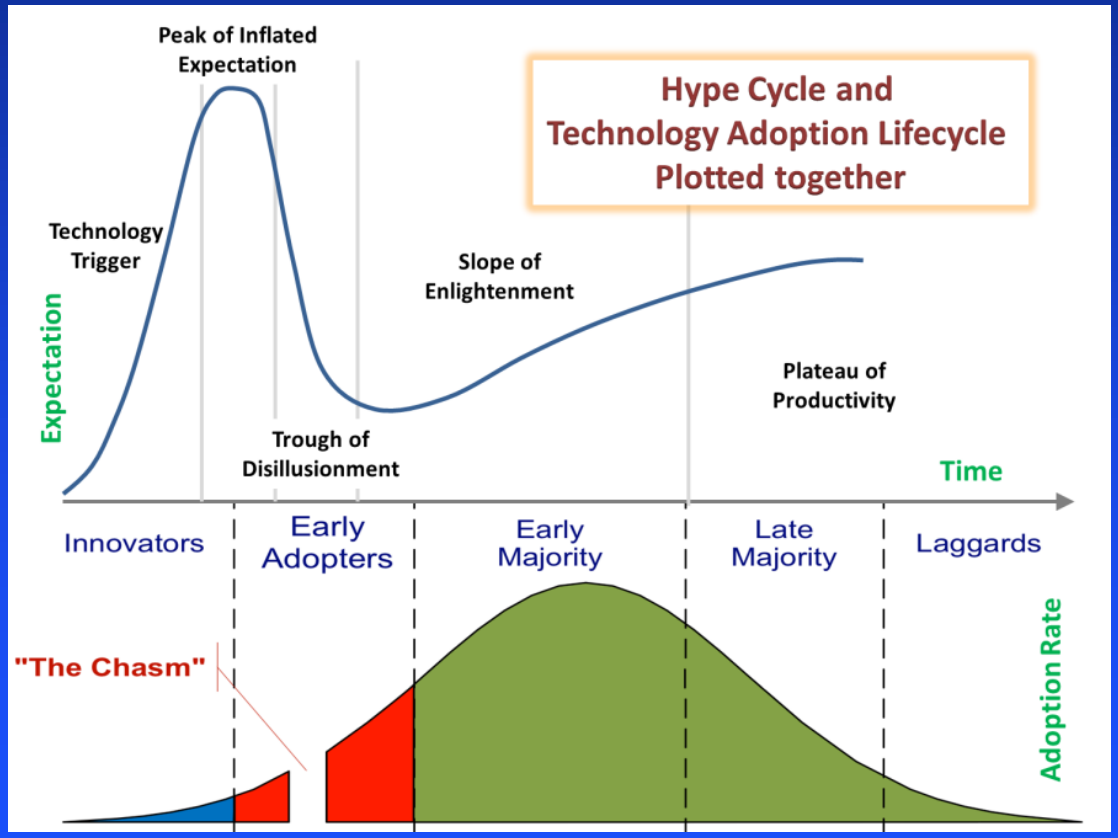
Now there is an analogous doubling phenomena seen for AI complexity measurable in months

ChatGPT and related models

Autonomous AI is inevitable- the singularity is coming…

The Silicon Valley timing question. When should you invest in/adopt AI?

When to adopt and why? Don't believe every consulting curve that you see



A Silicon Valley question. What should you build to win?

Best in class- one-off technology that detects cerebral aneurysms.

Platform- suite of integrated systems for multiple types of AI

Stand alone versus integrated (PACS/VR etc.)

The Wall Street Questions

Who will pay for AI and why?

Radiologists
Hospitals
Insurance companies
Patients?
…

The Wall Street Questions

Imaging giant RadNet loses $25M on AI segment but sees profitability ahead in 2024

Marty Stempniak / *March 01, 2023* / *Artificial Intelligence*

RadNet Inc. lost an estimated $25 million on its artificial intelligence segment last year, but sees profitability ahead for the burgeoning business line, leaders said Tuesday.

The Los Angeles-based imaging center operator has made a big play in AI recently, including buying two such firms last year for $100 million. Despite early losses, RadNet is seeing "significant strides" in commercializing its AI products, CEO Howard Berger, MD, told investors during the company's fourth quarter earnings call.

In November, the publicly traded company started implementing its new Enhanced Breast Cancer Diagnostic, or EBCD, offering AI-augmented breast cancer screening to patients for an additional fee. Berger expects all mammography centers to offer the AI add-on by summer 2023, but it will take a little bit longer for the program to operate in the black.

"Based upon early adoption data from several of our East Coast markets, we are anticipating our losses from AI in 2023 to significantly narrow as a result of EBCD revenue, and we project our AI segment to be profitable in 2024," Berger said in a statement.

In the meantime, RadNet said it continues to see promising results across its imaging center segment, which gathered more than $1.4 billion in revenue in 2022. When excluding any losses from AI, the company recorded roughly $209 million in 2022 earnings (before interest, taxes, depreciation and amortization). Year-over-year revenues were up roughly $112 million (8.5%), while adjusted earnings fell by $2.9 million (1.4%). Net income totaled $10.7 million, down $14.1 million year-over-year, with the $24.9 million pre-tax loss on AI (with revenue of $4.4 million) a key factor.

"Moving into 2023, the demand for diagnostic imaging remains robust and is growing," Berger said in the statement, estimating that RadNet has a dozen-plus new centers currently in development.

Until the AI segment turns a profit, RadNet said it will report financial results separately from its imaging centers. Berger said he expects this to continue through 2023, "providing transparency for our stakeholders to tack our progress." In its 2023 guidance, the company said it expects to earn between $16 million and $18 million in revenue from AI, with an anticipated loss of $9 million to $11 million (after adjusting for taxes and other factors).

RadNet bills itself as the "leading" operator of freestanding, fixed-site diagnostic imaging services. All told, the company has a network of 357 centers in markets including California, Maryland, Delaware, New Jersey, New York, Florida and Arizona. Its AI acquisitions, meanwhile, have included Aidence (focused on solutions for pulmonary nodule management and lung cancer screening), Quantib (specializing in prostate cancer and neurodegeneration), and DeepHealth (breast cancer detection).

A radiologist question. When/how should you use AI during a case?

During your scanning protocol

Toggle on/off

Final check

Never?

An ethicist question

Ethics of:

Data
Algorithms
Practices

Equity implications

The CMS question set

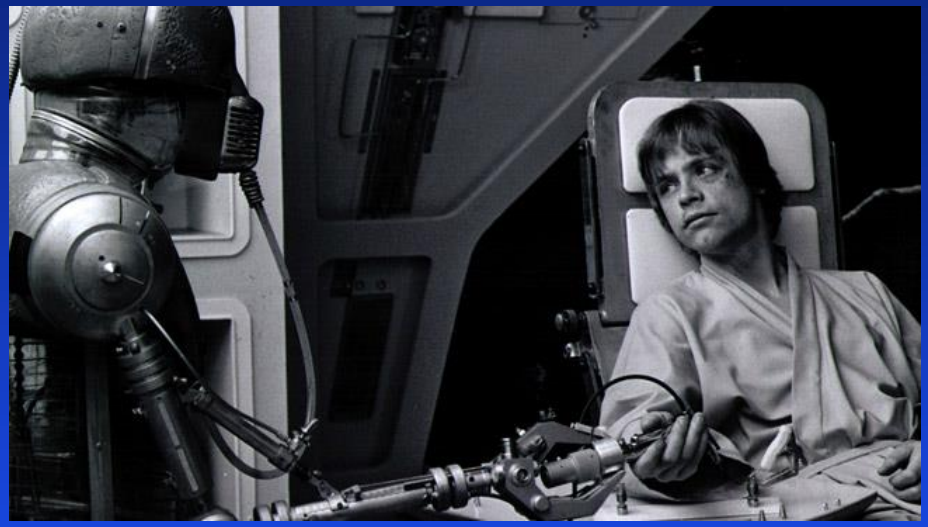
? New CPT code for every types of case use of AI

Brain tumor/MS/stroke/aneurysm etc.

? APMs vs. MIPS for AI use in QI

? Credit for Cost/Interoperability

Two science fiction views of future physicians:

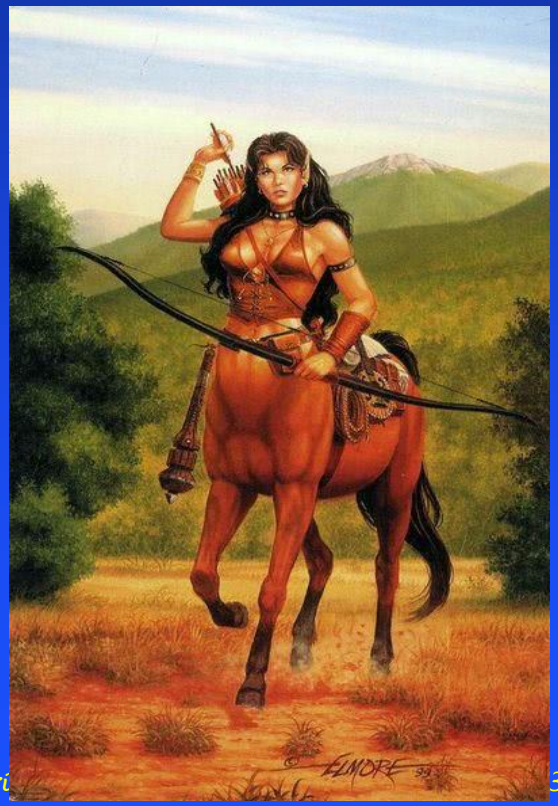


Robots replace humans
and humanoids as healers

Robots enhance human physicians

Centaurs in Myth and in Radiology

1. Augmented versus Irrelevant: I will become a ”centaur” radiologist



Thanks!

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- lexa@Wharton.upenn.edu

Misperception: focus on lagging indicators of burnout

Dysfunction at home

- Marriage and relationship issues, divorce
- Substance abuse
- Sleep disorders
- Eating disorders
- Neglect of hygiene and health
- Suicidal ideation
  - Approximately 400 physicians suicides per year in US. Higher than general population, particularly for female doctors-
  - http://emedicine.medscape.com/article/806779-overview-access May 11, 2016

How good are humans at reading diagnostic imaging studies?

Radiologic Errors and Malpractice: A Blurry Distinction

Leonard Berlin[1]

Medical error: Failure of a planned action to be completed as intended [1].

Medical malpractice: Unreasonable lack of skill. Failure of a physician…to exercise that degree of skill and learning commonly applied under all the circumstances in the community by the average prudent reputable physician with the result of injury…to the [patient] [2].

Approximately 4% of radiologic interpretations rendered by radiologists in their daily practice contain errors [3]. Fortunately, most of these errors are of such minor degree, or if serious are found and corrected with sufficient promptness, that they do not cause injury to patients. Nevertheless, many radiologic errors do harm patients and, as a result, medical malpractice lawsuits are generated. If it is determined by a judge or jury that the diagnostic error committed by a defendant–radiologist was the result of negligence, in other words, a breach of the standard of medical care, the radiologist will be held liable and compensation will be awarded to the plaintiff–patient. On the other hand, if the defendant's radiologic error is found not to be due to negligence, litigation is terminated without compensation. It follows then that certain radiologic errors result from radiologists' negligent conduct, and others do not. One may then logically ask whether these two kinds of radiologic errors, those that constitute negligence and those that do not, can be distinguished and if so, how? This article will attempt to seek an answer to these questions.

Malpractice Defined

In order for a radiologist or any other physician to be found liable for—that is, "guilty" of—medical malpractice, four elements must be established. There must be a physician–patient relationship [4, 5], the radiologist must have sustained an injury. Except in unusual circumstances, three of these four elements—the physician–patient relationship, proximate cause, and patient injury—are not contentious issues in a lawsuit. The remaining allegation that must be proven for a plaintiff to succeed in a malpractice lawsuit, the one claiming that the defendant's conduct has breached the standard of care, is the most frequently contested. Inasmuch as nearly 75% of all medical malpractice lawsuits lodged against diagnostic radiologists allege negligence related to errors in diagnosis [7], our discussion here will be limited to the relationship between radiologic errors and malpractice.

American law derives from three sources: constitutional law, generated by federal and state constitutions and their subsequent interpretations by the courts; statutory law, rules and regulations enacted by state and federal legislatures; and the "common law," based on judicial decisions that serve as precedents on which courts base future decisions. The common law is a legacy of America's early English colonists [8]. It is the product of a continuum of state appellate and supreme court decisions and thus is constantly evolving.

At the conclusion of a medical malpractice trial, the "trier of fact" (usually the jury, occasionally the judge) determines whether the conduct of the defendant–physician constituted negligence. Before deliberation, jurors are instructed on the law by the presiding judge. The judge explains that medical negli-

Keywords: malpractice, medical–legal, radiologic errors

DOI:10.2214/AJR.07.2209

Received March 5, 2007; accepted without revision March 18, 2007.

[1]Department of Radiology, Rush North Shore Medical Center, 9600 Gross Point Rd., Skokie, IL 60076, and Department of Radiology, Rush Medical College, Chicago, IL. Address correspondence to L. Berlin (lberlin@rsh.net).

Distribution of products

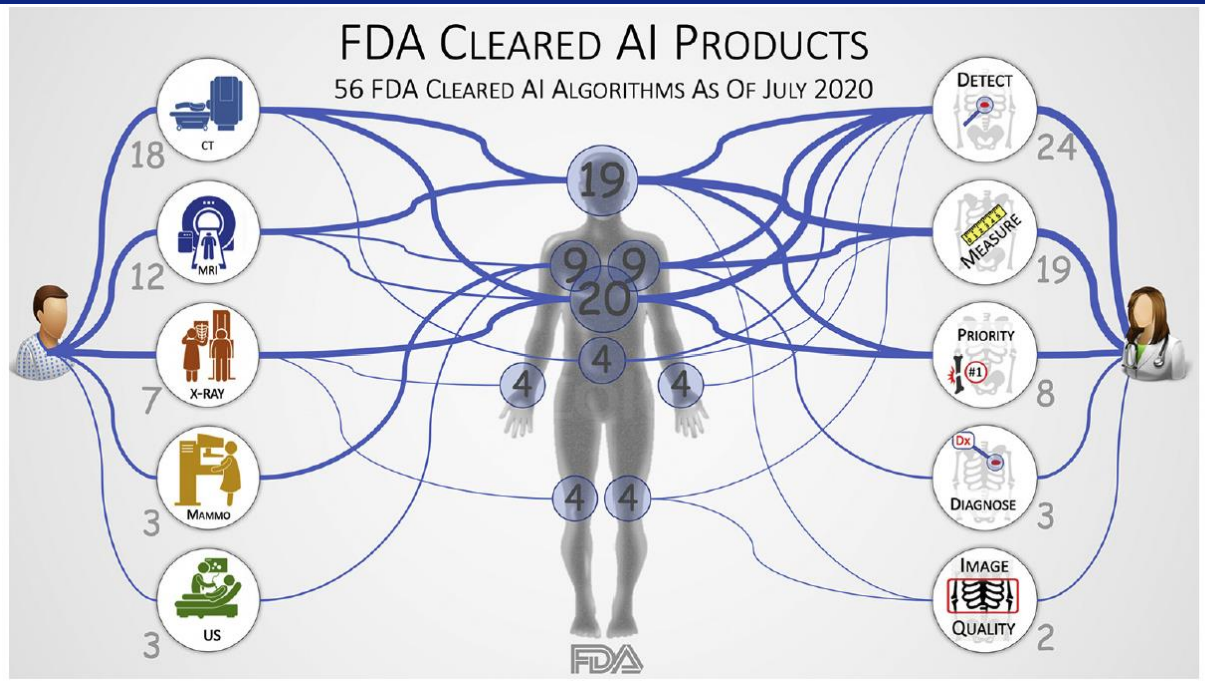


Fig. 4. Clinical and industry alignment. The numbers represent the number of FDA-cleared algorithms relative to the various modalities, anatomic areas and intended use. The survey results compared to FDA-cleared algorithms show good alignment between clinical needs and industry development. AI = artificial intelligence; FDA = Food and Drug Administration; Mammo = mammography; US = ultrasound.

If AI is the answer, what is/are the questions?

AI will help with scheduling, workflow, and making better images.

AI will enhance my interface experience: hanging, windowing, finding things in the EMR, measuring and comparing, etc.

AI will do most/all of my reporting for me

AI will make findings and diagnoses to enhance my work

If AI is the answer, what is/are the questions?

AI will make findings and diagnoses for me

AI will make findings and diagnoses for other non radiologist physicians

AI will make findings and diagnoses for NPs and PAs

AI will work on its own for hospitals, PE companies etc.

Maslach burnout inventoy

SCORING RESULTS - INTERPRETATION

Section A: Burnout

Burnout (or depressive anxiety syndrome): Testifies to fatigue at the very idea of work, chronic fatigue, trouble sleeping, physical problems. For the MBI, as well as for most authors, "exhaustion would be the key component of the syndrome." Unlike depression, the problems disappear outside work.

- Total 17 or less: Low-level burnout
- Total between 18 and 29 inclusive: Moderate burnout
- Total over 30: High-level burnout

Section B: Depersonalization

"Depersonalization" (or loss of empathy): Rather a "dehumanization" in interpersonal relations. The notion of detachment is excessive, leading to cynicism with negative attitudes with regard to patients or colleagues, feeling of guilt, avoidance of social contacts and withdrawing into oneself. The professional blocks the empathy he can show to his patients and/or colleagues.

- Total 5 or less: Low-level burnout
- Total between 6 and 11 inclusive: Moderate burnout
- Total of 12 and greater: High-level burnout

Section C: Personal Achievement

The reduction of personal achievement: The individual assesses himself negatively, feels he is unable to move the situation forward. This component represents the demotivating effects of a difficult, repetitive situation leading to faiure despite efforts. The person begins to doubt his genuine abilities to accomplish things. This aspect is a consequence of the first two.

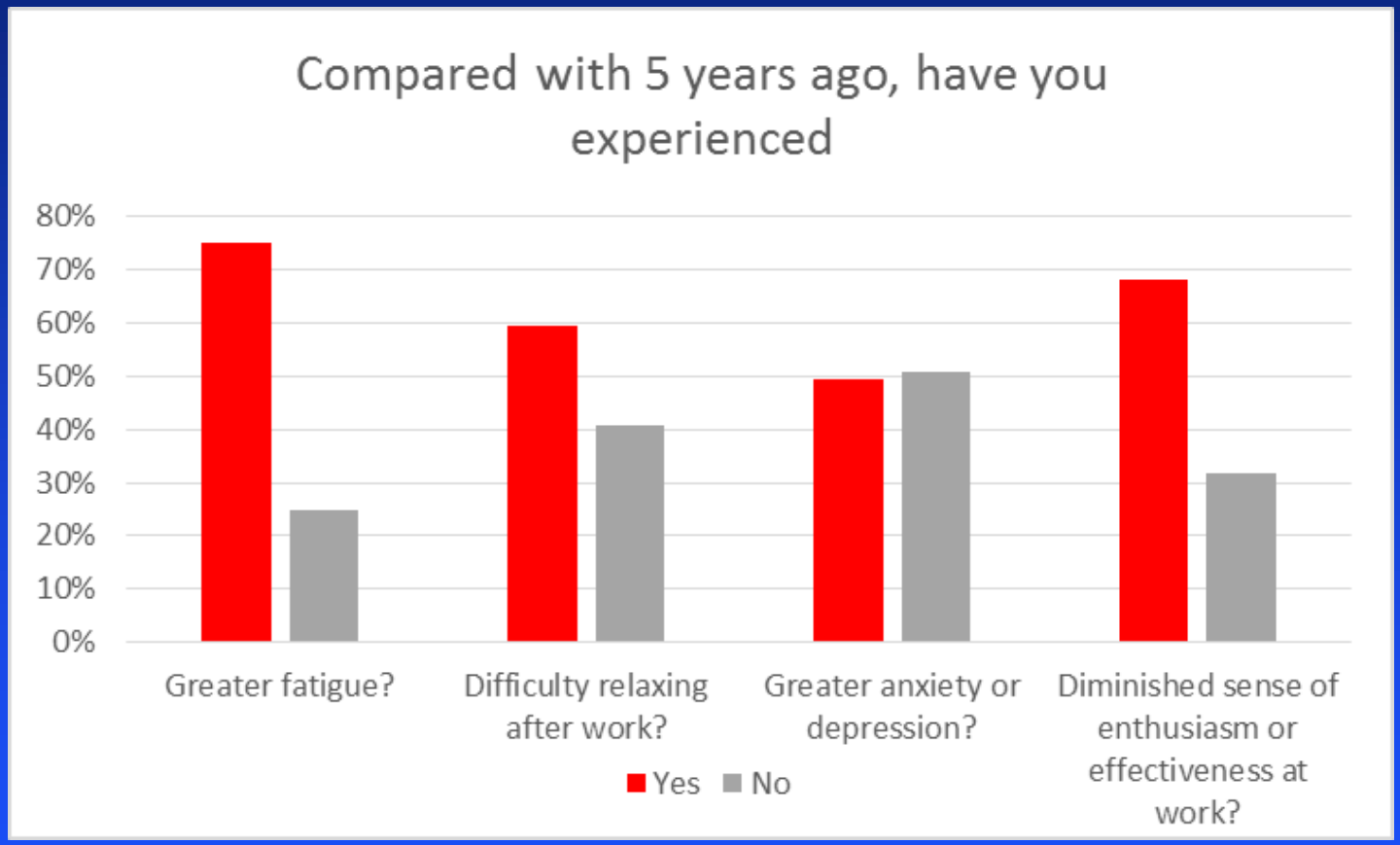
- Total 33 or less: High-level burnout
- Total between 34 and 39 inclusive: Moderate burnout
- Total greater than 40: Low-level burnout

Keys to diagnosing burnout

- Burnout is defined as a syndrome that arises in the setting of prolonged work-related stress
- Core features: emotional exhaustion, callousness or apathy towards patients or peers, and feelings of personal inadequacy.
- Increased rates of substance abuse, depression, and suicide have been linked to physician burnout, as have medical errors and lapses in patient safety.
- Disruptive workplace behaviors, such as presenteeism (which is reduced productivity due to physical or emotional dysfunction), absenteeism (which is nonparticipation in work), high employment turnover, and early retirement also have been linked to physician burnout and depression...

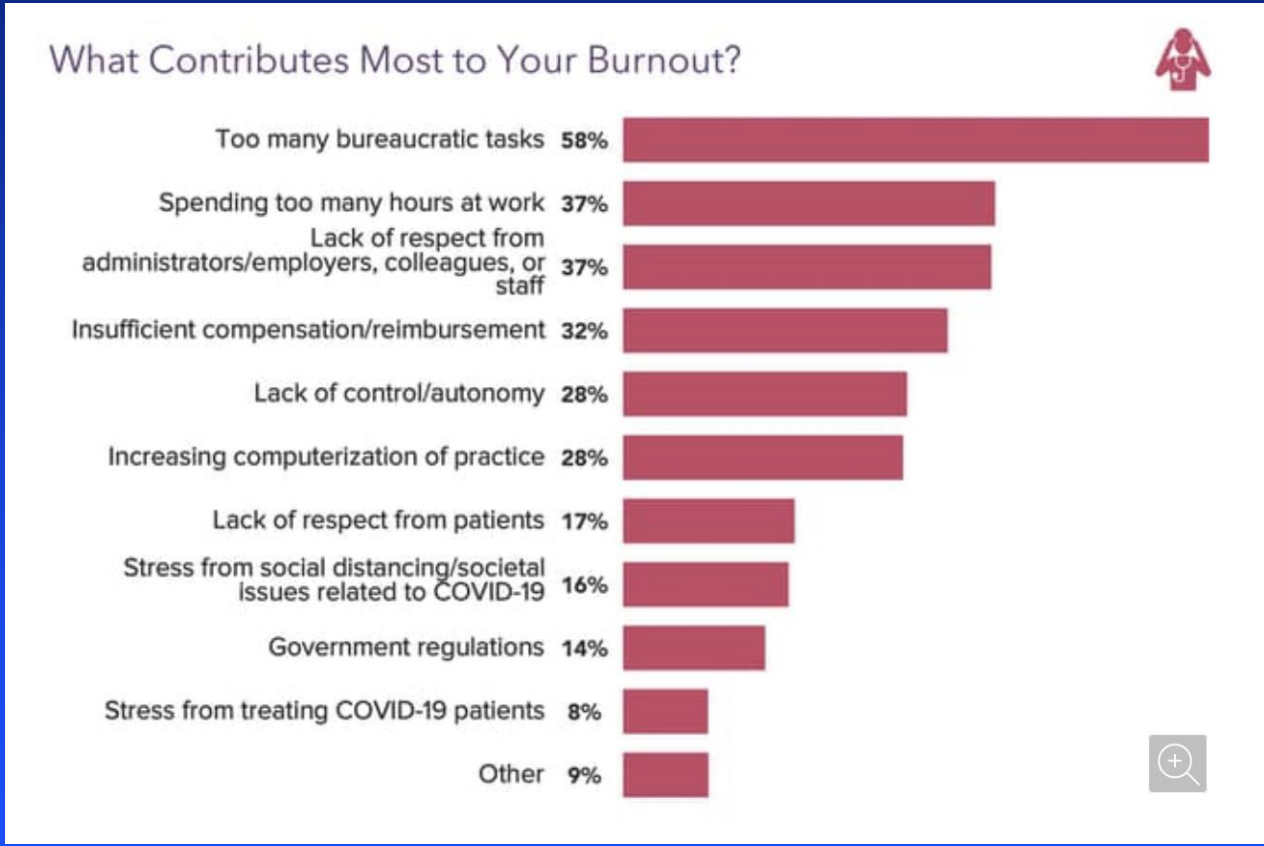
Curr Probl Diagn Radiol. 2015 Sep-Oct;44(5):389-90. Burnout in Radiology.Nicola R1, McNeeley MF2, Bhargava P

High Burn-Out in Neuroradiologists Overall



J.Y. Chen and F.J. Lexa Baseline Survey of the Neuroradiology Work Environment in the United States with Reported Trends in Clinical Work, Nonclinical Work, Perceptions of Trainees, and Burnout Metric American Journal of Neuroradiology July 2017, 38 (7) 1284-1291; DOI: https://doi.org/10.3174/ajnr.A5215

Perceived causes of burnout



Burnout: It is real and it can be spectacular

Like PTSD, burnout has often been dismissed as a character flaw, a weakness, “faking” etc.

Like PTSD, it is real and can happen to the best of us, despite good character, good training, etc.

Focus on individual differences has created a tendency to ignore other factors. In reality, is often an environmental problem rather than an individual one. We ignore that causal relationship to our detriment

One way of re-framing the argument: zdoggmd.com/moral-injury

Burnout leading (early) indicators

- Three D's
- Disengagement
- Disinterest
- Disconnection

- Loss of communication, truancy, diminished excitement/passion, distraction-internet etc., cynicism, anger—new- not chronic

Misperception: focus on lagging (late) indicators of burnout

- Dysfunction at work:
- Poor performance
- Malpractice
- Overt anger- yelling, throwing, physical abuse
- Inappropriate behavior

What is to be done?

V.I. Lenin

Obvious answers to burnout

- Read fewer cases per hour
- Work at the level of your training for as much of the workday as possible (not below and not above)
- Consider some of the lessons of the aviation industry regarding duty hours, limits on sleep deprivation etc.
- Take breaks
- Avoid isolation at work
- Etc.

(sur)real answers to radiologist burnout…

- Nap more
- Yoga
- Herbal tea
- Mindfulness
- Exercise more
- Watch what you eat
- Get a pet

Preventing burnout in radiology- ACR report on impact high to low

- Adequate staffing
- Reduce prolonged stress
  - Titrate change, orientation, integration
- Sense of control
- Reduce night and weekend call obligation
- Restore lifestyle balance
  - Physical
  - Emotional/spiritual
  - Relationship
  - Work/life balance

Burnout of Radiologists: Frequency, Risk Factors, and Remedies: A Report of the ACR Commission on Human Resources
Harolds, Jay A. et al. Journal of the American College of Radiology , Volume 13 , Issue 4 , 411 - 416

Preventing burnout in radiology- ACR report on impact high to low

- Efficiency support
  - Scribes and other FTEs, better technology- PACS
- Develop Reasonable Financial Expectations
  - Hire enough radiologists to keep work reasonable
- Reduce isolation of radiologists
- Seek professional help

Burnout of Radiologists: Frequency, Risk Factors, and Remedies: A Report of the ACR Commission on Human Resources
Harolds, Jay A. et al. Journal of the American College of Radiology , Volume 13 , Issue 4 , 411 - 416

Steps in prevention and treatment

- Control- give radiologists as much control over their work and the work environment as you can
- Teamwork- “we are in this together”- cooperation and relationships work better for most of us then sitting at home in the dark in the basement
- Milestones: accomplishment and anticipation
- Workplace improvements- breaks, food, exercise, etc.
- Leadership training: Leadership is too important to be left to the “leaders”-FJ Lexa, 2003

Thanks!

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