

Harrisburg University of Science and Technology

Digital Commons at Harrisburg University

Dissertations and Theses

Healthcare Informatics, Graduate (HCMS)

Spring 2023

Will Clinical Decision Support Mechanisms reduce the amount of unnecessary computed tomography?

Andrea Ciarmello

Harrisburg University of Science and Technology

Follow this and additional works at: https://digitalcommons.harrisburgu.edu/hcms_dandt



Part of the [Analytical, Diagnostic and Therapeutic Techniques and Equipment Commons](#), and the [Health Information Technology Commons](#)

Recommended Citation

Ciarmello, A. (2023). *Will Clinical Decision Support Mechanisms reduce the amount of unnecessary computed tomography?*. Retrieved from https://digitalcommons.harrisburgu.edu/hcms_dandt/11

This Thesis is brought to you for free and open access by the Healthcare Informatics, Graduate (HCMS) at Digital Commons at Harrisburg University. It has been accepted for inclusion in Dissertations and Theses by an authorized administrator of Digital Commons at Harrisburg University. For more information, please contact library@harrisburgu.edu.

Will Clinical Decision Support Mechanisms reduce the amount of unnecessary computed
tomography?

Andrea May Ciarmello BSRT (R) (CT)

HCIN 699 Healthcare Informatics

Harrisburg University

Abstract

Clinical Decision Support Mechanisms (CDSMs) are to patient safety. When used in Radiology, CDSMs can improve radiation dose, quality assurance, and patient care. When paired with the electronic health record, CDSMs provide clinicians with patient-specific data that will help lower healthcare costs and improve patient outcomes. This study demonstrates how introducing clinical decision support mechanisms in electronic health record software will help improve unnecessary CT scans and hinder patient radiation exposure. The ordering physician can now consistently and reliably choose the proper scan each time.

Keywords: Radiology, Diagnostic Imaging, Medicare, Clinical Decision Support Mechanisms, Computed Tomography

Introduction

Unnecessary CT scans continue to occur in Radiology. Unnecessary imaging can cause an array of consequences for the patient, including increased cost, increased radiation exposure, mental anguish, anxiety, and episodes of claustrophobia. The abundance of scans has inflated healthcare costs, which, in turn, caused the Center of Medicare Services (CMS) to examine spiraling costs and to work on a solution.

"The Protecting Access to Medicare Act (PAMA) of 2014 created the Appropriate Use Criteria Program. With the help of provider-led entities, such as the American College of Radiology (ACR), and the Appropriate Use Criteria (AUC) was devised." (CMS,2022) Along with a CMS qualified CDSM the AUC provides specific radiology studies for the given diagnosis. The AUC works on a rating scale and recommends the most appropriate one. The American Medical Association began a training phase of the program in 2020 to teach physicians and radiologists how to use clinical decision support mechanisms. A penalty phase of the CMS program was set for implementation on January 1, 2023, but is currently on indefinite hold.

Problem

Due to the overordering of unnecessary diagnostic imaging tests, CMS has mandated the use of Appropriate Use Criteria that ordering clinicians must follow to acquire reimbursement by Medicare. Appropriate Use Criteria (AUC) helps clinicians choose the correct study for the given diagnosis. The overutilization of CT scans has increased healthcare costs, increased radiation exposure, and played a significant role in overdiagnosis and overtreatment of patients.

Background

The field of radiology has grown tremendously in the last century, from the discovery of the x-ray in 1895 by Wilhelm Roentgen to the invention of computed tomography

in 1972. Innovations in radiology have established CT as the study of choice for acute and emergent situations. "The latest research shows approximately 80 million CT scans are completed in the U.S. annually compared to 3 million in 1980." (Miglioretti,2011) Computed tomography uses x-rays to take three-dimensional views of the organ or body part of interest. The most significant clinical concern in the overuse of CT is the increased radiation dose to patients. The risk of developing adverse health effects depends on the cumulative radiation dose. The higher the dose and the more frequent the exposures, the higher the risk of adverse effects. Excess radiation from inappropriate scans increases the overall lifetime risk.

Inappropriate pediatric CT scans expose children to larger lifetime radiation doses and add to repeat scans that occur due to motion or inability to take direction. "The use of CT has multiplied since the late 2000s and has caused the US gross domestic product to increase, mostly due to the cost of imaging technologies. The increase of healthcare costs in the US is at an all-time high." (Howell,2021)

The increasing healthcare costs showed that advanced imaging expenditure in Medicare beneficiaries rose over 85%. Estimated inappropriate orders of CT and MRI (Magnetic Resonance Imaging) made up over 26%." (Zygmunt,2022) In the past, the ordering clinician would call the radiologist to select the protocol for the CT. However, because the radiologists' workload is increasing by over 330%" (Ginocchio, 2022, pp. 438-444), the protocols selected by the radiologist occur less frequently. The CT technologists worked to detect potentially wrong orders and inform the ordering clinicians that they were ordering the wrong study. The technologists were commonly met with uncooperative physicians or physician assistants who did not choose to listen to them or did not believe the order came from a radiologist. The increase in

inappropriate orders caused CMS to establish a corrective program by the Protecting Access to Medicare Act of 2014.

Overview of PAMA and AUC.

The program established by the Protecting Access to Medicare Act (PAMA) of 2014, Section 218(b), requires that all “Medicare beneficiaries having advanced imaging ordered must have consulted with a clinical decision support mechanism to make sure the patient is having the correct test ordered. The advanced imaging modalities that need further recommendation on orders include MRI. (Magnetic Resonance Imaging), Nuclear Medicine Technology including PET (Positron Emission Tomography), and PET-CT and CT (Computed Tomography).” (Golding,2020) This study examines CDSM (Clinical Decision Support Mechanism), and the perceptions of the impact on computed tomography.

An example of the appropriate use criteria would be a pediatrician ordering a CT of the abdomen and pelvis on a twelve-year-old with diffuse abdominal pain. The ordering pediatrician would consult the clinical decision support mechanism and check the appropriate use criteria rating. The tool in his example reads: “The scale ranges from one through nine, with nine being the most appropriate. Separated into three categories, one through three being inappropriate, four through six falling into an uncertain category, and seven through nine ranked the most appropriate.” (Kurth,2021) The first choice of imaging for the child in the AUC would be an ultrasound of the abdomen and pelvis, and the second choice would be an MRI of the abdomen and pelvis. A CT would only be appropriate in an emergency setting due to the amount of ionizing radiation involved. The research done on this tool was published as "Awareness, Utilization, and Education of the ACR Appropriateness Criteria: A Review and Future Directions" by the American College of Radiology (Sheng, Castro,2016) The ACR AUC includes

over 200 selections, based on patient conditions, cost, variation in practice, and mortality as a guide to improving patient care. The AUC assists clinicians in making the most appropriate choice in medical imaging for the patient’s specific health problem. Here is an example of the Appropriate use criteria scale from ACR.

Radiological Exam Procedure	Appropriate Criteria Scale 1=Least appropriate 9= Most appropriate									Comments
	1	2	3	4	5	6	7	8	9	
Right Upper Quadrant Pain. Fever, elevated WBC, positive Murphy sign.										
US, abdomen									X	
X-ray, upper GI series				X						
X-ray, abdomen				X						
X-ray, colon, barium enema				X						
CT, abdomen				X						
Fever, elevated WBC, positive Murphy sign, normal gallbladder ultrasound.										
CT, abdomen						X				
X-ray, abdomen						X				
X-ray, upper GI series						X				
US, abdomen, repeat within 24 hours				X						
X-ray, colon, barium enema			X							
Right Upper Quadrant Pain. No fever, normal WBC.										
US, abdomen									X	
CT, abdomen							X			
NUC, cholescintigraphy						X				
X-ray, upper GI series						X				
X-ray, abdomen				X						
X-ray, colon, barium enema				X						
No fever, normal WBC, ultrasound shows only gallstones.										
NUC, cholescintigraphy								X		
X-ray, upper GI series						X				
CT, abdomen						X				
X-ray, abdomen				X						
X-ray, colon, barium enema				X						
Acute Pancreatitis. Etiology unknown, first episode of pancreatitis.										
US, abdomen								X		
CT, abdomen						X				With or without contrast.
Acute Pancreatitis. Severe abdominal pain, elevated amylase lipase, fever, Elevated white blood cell count.										
CT, abdomen								X		With or without contrast.
US, abdomen							X			

Research continues to examine the results of increased healthcare costs for Medicare patients and the relationship to unnecessary imaging. Discussions between ordering clinicians and radiologists provide ordering clinicians with much-needed education. “R-SCAN (Radiology

Support, Communication, and Alignment Network) is a quality improvement program where patients, referring clinicians, and radiologists collaborate to improve imaging appropriateness based on Choosing Wisely recommendations and ACR Appropriateness Criteria. When applying the R-Scan cohort, A substantial cost reduction totaling \$260,000 over 3.5 months. When extrapolated to the Medicare population, the potential cost reductions in lesser value imaging totaled \$433 million yearly.” (Wintermark,2021)

Research Questions

Question 1: Will implementing Clinical Decision Support Mechanisms improve unnecessary computed tomography scans?

Question 2: Will an enforced penalty from CMS bring more communication in ordering the correct scan?

Literature Review

The journal articles and other literature reviewed here will help to illustrate the importance of CDSM and how vital it is to make an informed decision on the correct scan to order.

According to Smith-Bindham, and Miglioretti (2019), research has shown that sixty-two million computed tomography scans were done in 2007 and are increasing by 10 percent annually. The latest research shows that we are averaging approximately 80 million CT scans in the US annually, compared to three million in 1980. Technology has grown exponentially over the last 40 years.

The article "The CT Scan after 50 years — Continuity and Change" was published in the New England Journal of Medicine by Howell (2021) It documents the changes in CT over the last 50 years. The late 2000s have seen an ever-growing number of CT scans in the US and the

gross domestic product has been rising yearly, in part due to the cost of imaging technologies. Healthcare costs in the US are now at an all-time high.

The Journal entry in "Current Problems in Diagnostic Radiology" written by Ginocchio and McMenemy, (2022) shows that a significant part of a radiologist's job is to monitor the appropriateness of ordered studies and to relay to ordering Physicians and CT Technologists the correct CT scan to choose. In the last decade across the US, radiologist workload has increased 10—fold between 1999 and 2010 due in great part to a 330% increase in computed tomography scans.

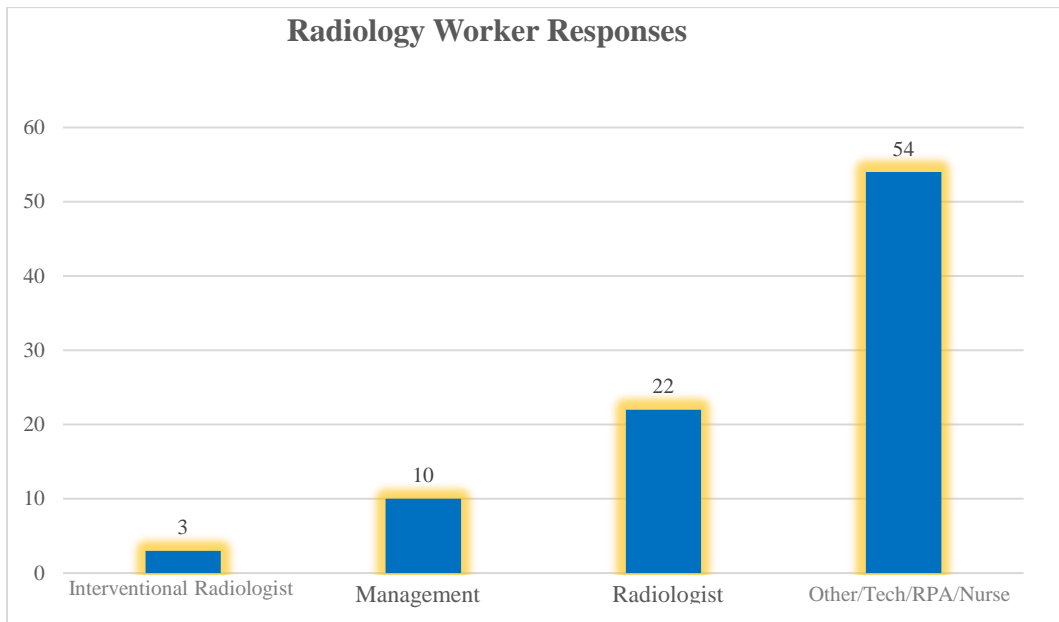
A study done on Clinical Decision Support's impact on imaging utilization (Zygmunt, Ikuta, Nguyen, Frigini, Segovis & Naeger2022) showed that imaging expenditures for Medicare beneficiaries rose over 85%. Estimated inappropriate orders of CT and MRI were 26% of all orders. The educational and operations test period for the Medicare CDSM rules started July 1, 2018, and the penalty phase for non-use was supposed to start on January 1, 2023. The date was postponed indefinitely, partly due to the COVID pandemic. This waffling has caused the radiology community to wonder when and if Medicare will enforce the penalty phase of this plan. Health care providers will be required to consult Medicare-qualified clinical decision support mechanisms before ordering any advanced diagnostic imaging.

A study performed at the Henry J. Kaiser Family Foundation (Cubanski and Newman 2019) explains the facts on Medicare spending and financing. It shows that in 2016, Medicare funding comprised 15% of the federal budget and by 2027 expectations will rise to 17.5%. Medicare accounts for 20 percent of national health care costs and is 4.2% of the US GDP by 2027.

Methodology

The research questions above were addressed with two methods: (1) reviews of published literature from websites Science Direct, PubMed, The Journals of the American College of Radiology, Diagnostic Imaging Journals, Academic Radiology, and Elsevier, as well as research data from the Agency on Healthcare Research and Quality (AHRQ); and (2) a Qualtrics-based anonymous research survey using a convenience sample of radiology personnel posted on February 27, 2023 to LinkedIn.com. The survey population included radiologists, radiologist physician assistants, radiology nurses, radiologic technologists, and radiology administrative personnel. The survey closed on March 10, 2023. The survey questions are included with the graphs of results.

Survey Data and Results:



Out of eighty-nine answers from all participants, twenty-two radiologists and three interventional radiologists comprised 27.17% of all answers, radiology management was 10.87%, and the remainder comprised other radiology workers, including radiology

technologists, radiology physician assistants, and radiology nurses totaling 54.37%. A Chi-square test showed a statistically significant difference between the number of radiologists versus other non-radiologist responses. ($p < 0.05$)

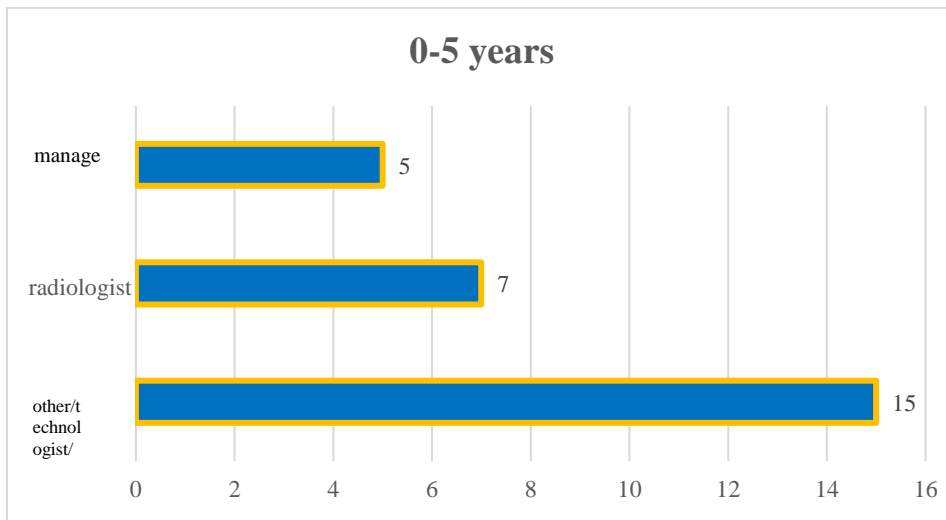
Table 1.1 Radiologists vs. all other respondents.

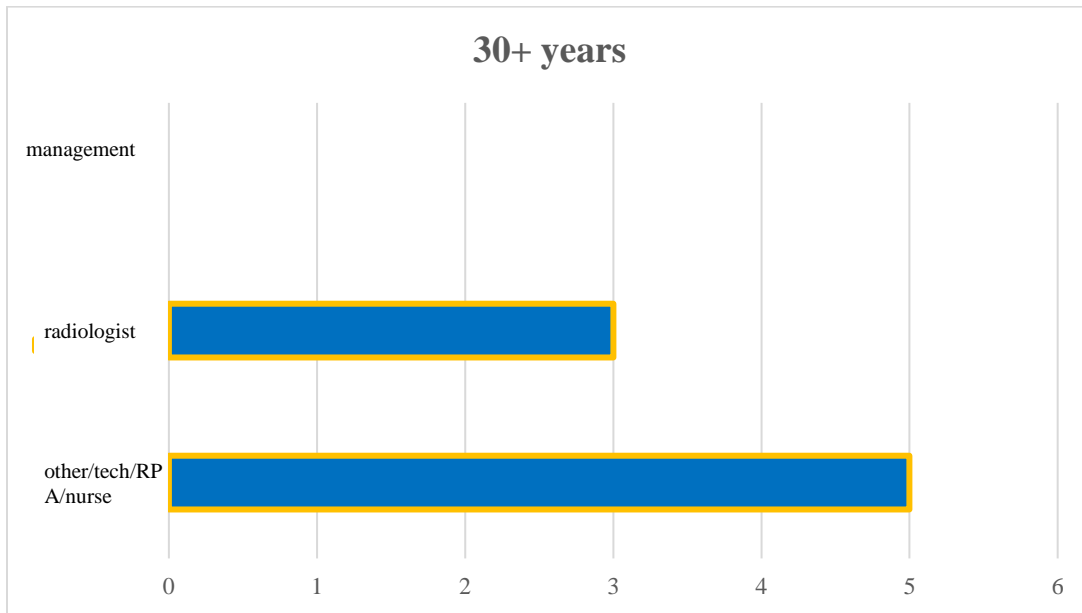
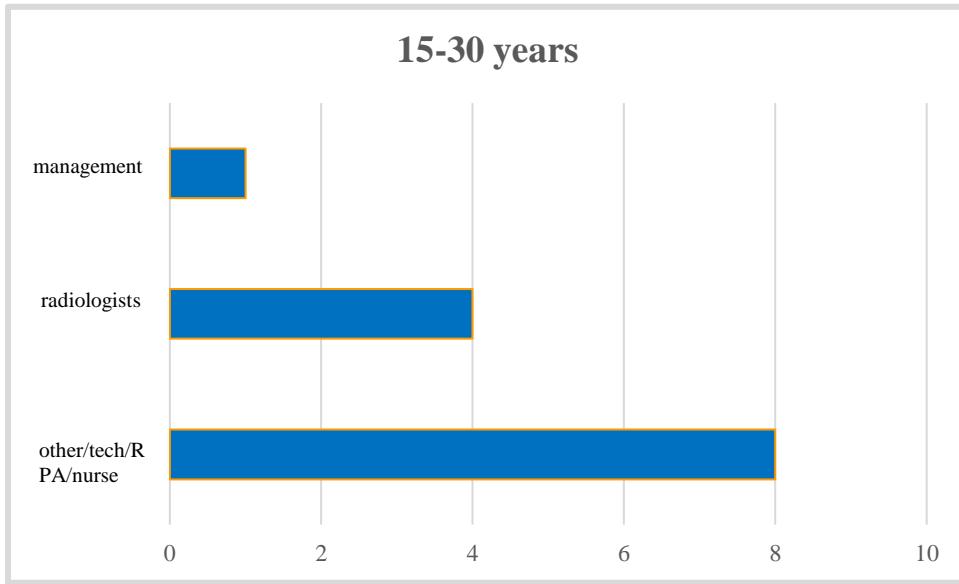
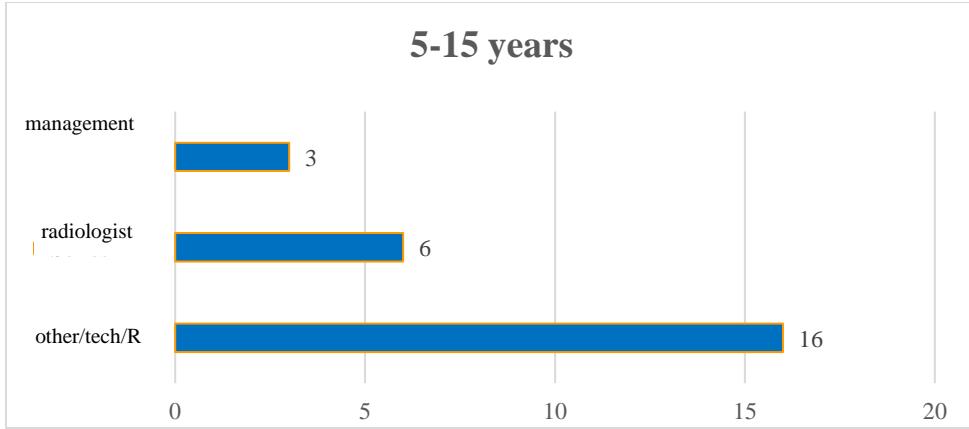
Actual	Expected
25	50
64	50
P = 5.0747E-05	

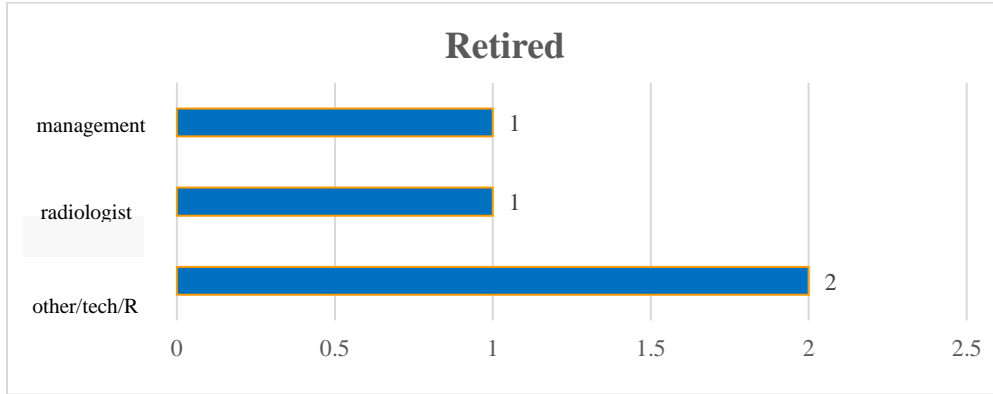
The Chi-square test shows that radiologists were not equally represented in this survey.

Subgroup analyses were limited by small cell numbers.

How many years have you been working?

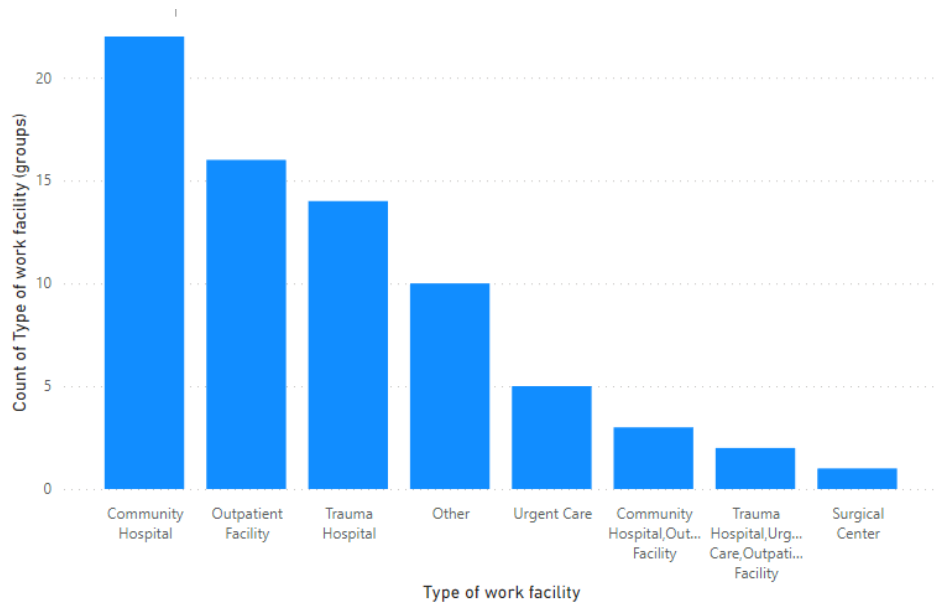






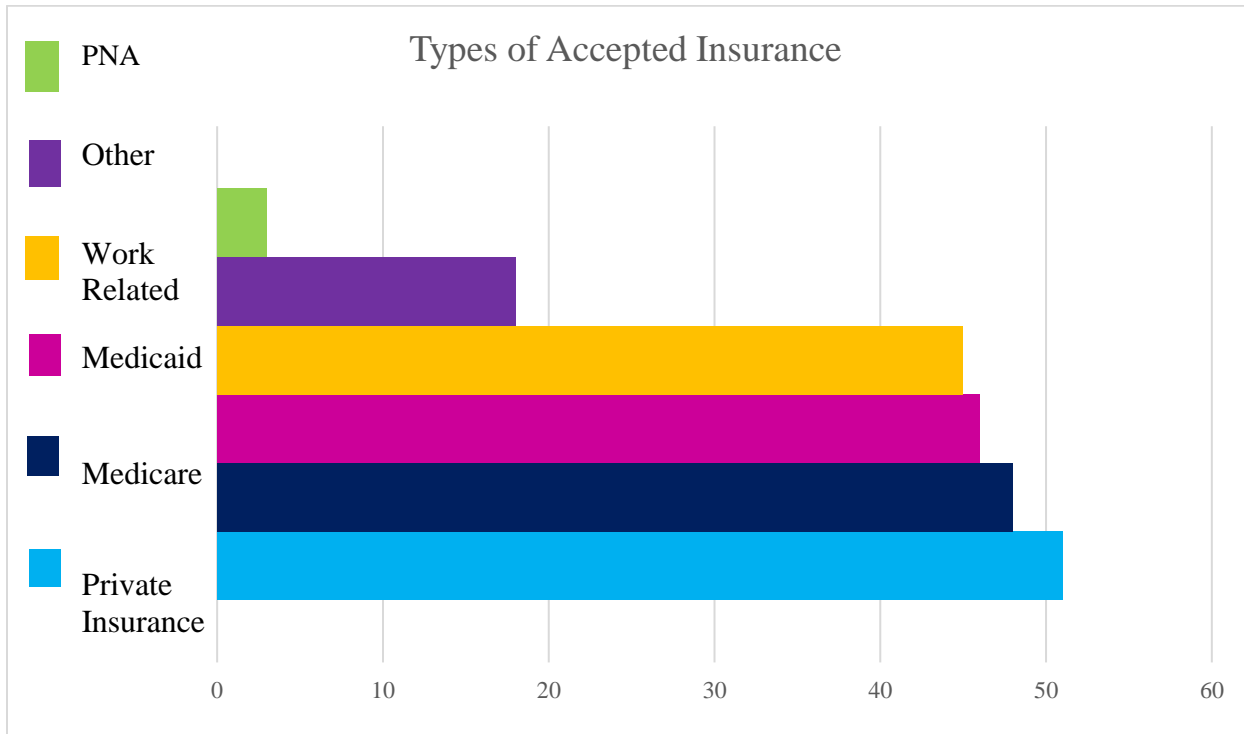
Of all experience levels, 0-5 years of total work experience was the highest among "Other/ Radiology Technologists/R.P. A/Radiology Nurses." The second highest total work years was 5-15 years, with the radiologists at 32.47%. The 15-30 years category ranked third among all the radiology workers and radiologists.

Participants' work environments.



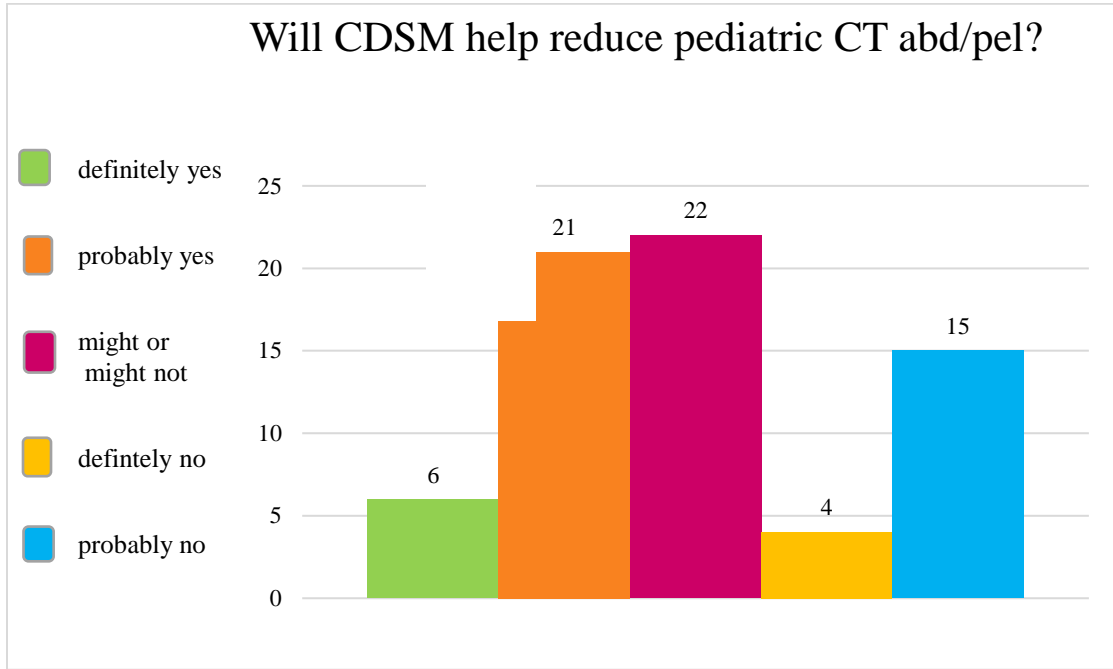
Community hospital was the most common place of employment for the responding radiology workers. Outpatient facilities were second at 25.26%.

Accepted insurance of participants



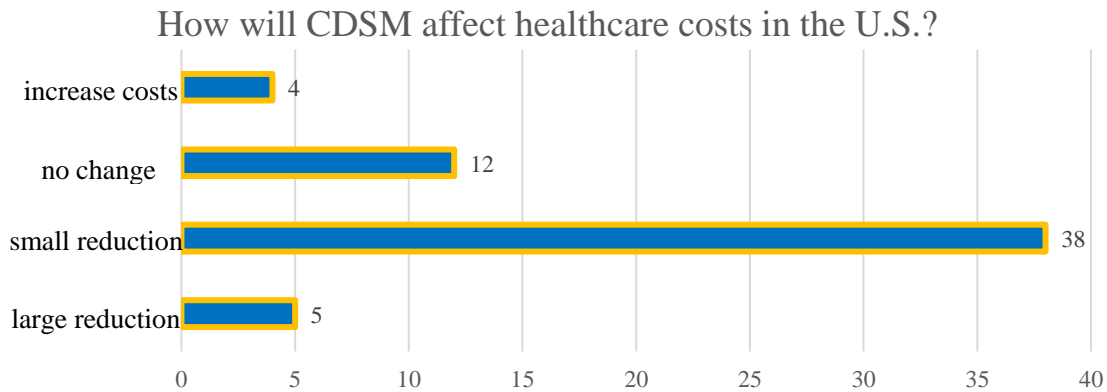
Private insurance was the most accepted form of payment at 24.17%, out of fifty-one participants. Community hospitals ranked first, and outpatient facilities second for accepting private insurance payments. Reimbursement from Medicare ranked second at 22.8%, with forty-eight participants accepting Medicare. Forty-five participants of the survey accepted Medicaid insurance. Three participants preferred not to answer. Private insurance, Medicare and Medicaid were accepted by over 51% of respondents.

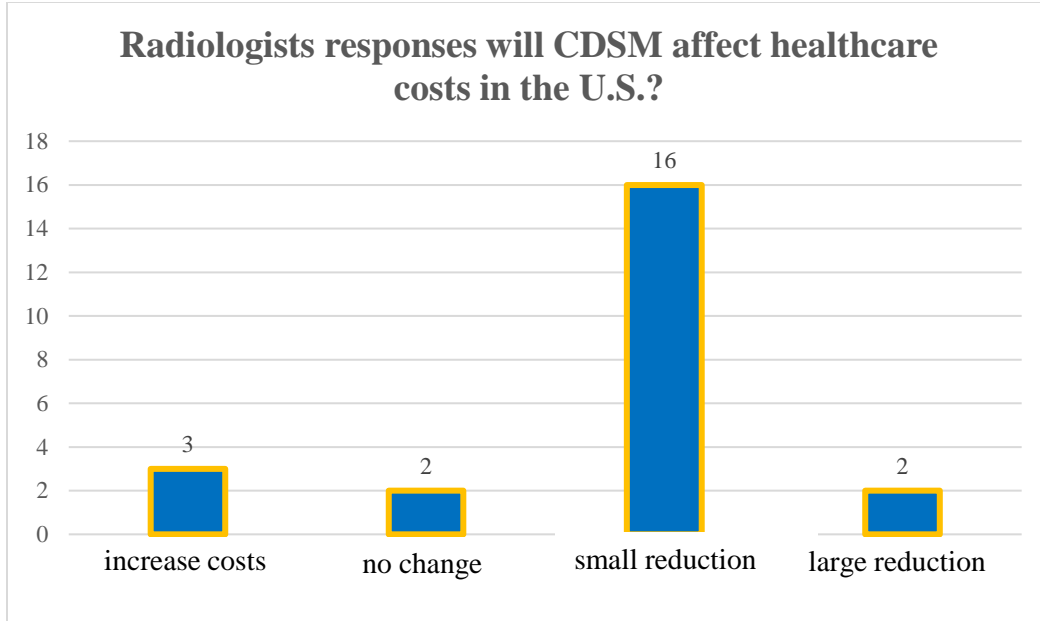
Do you feel that Clinical Decision Support Mechanisms will help reduce pediatric CT abdomen and pelvis CT?



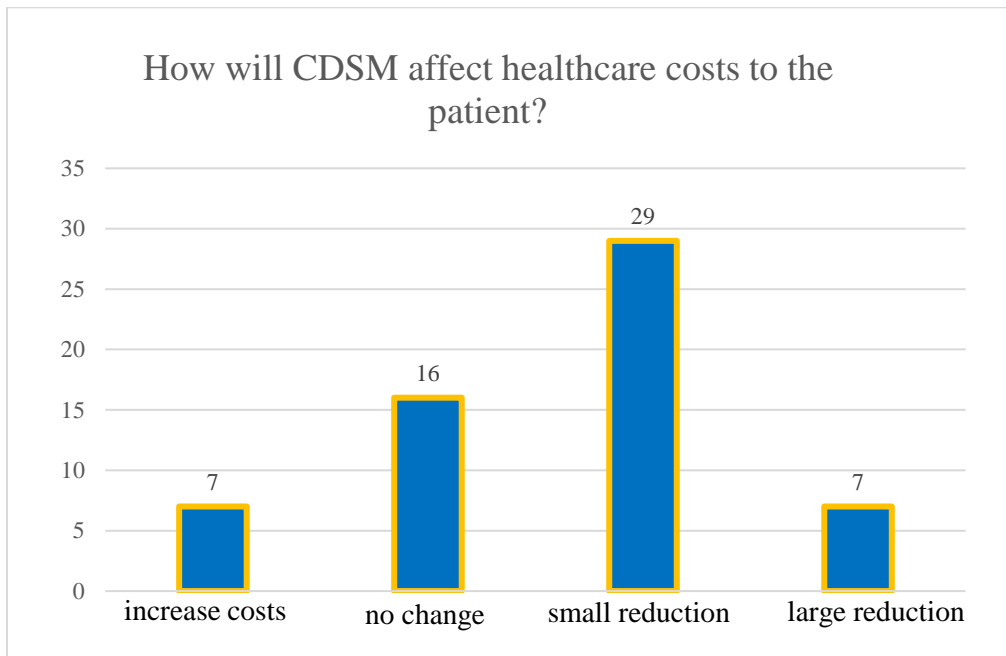
Many radiology workers chose “probably not,” and the radiologists highest response chose “might or might not.” The radiologists also chose “probably not” as their second choice.

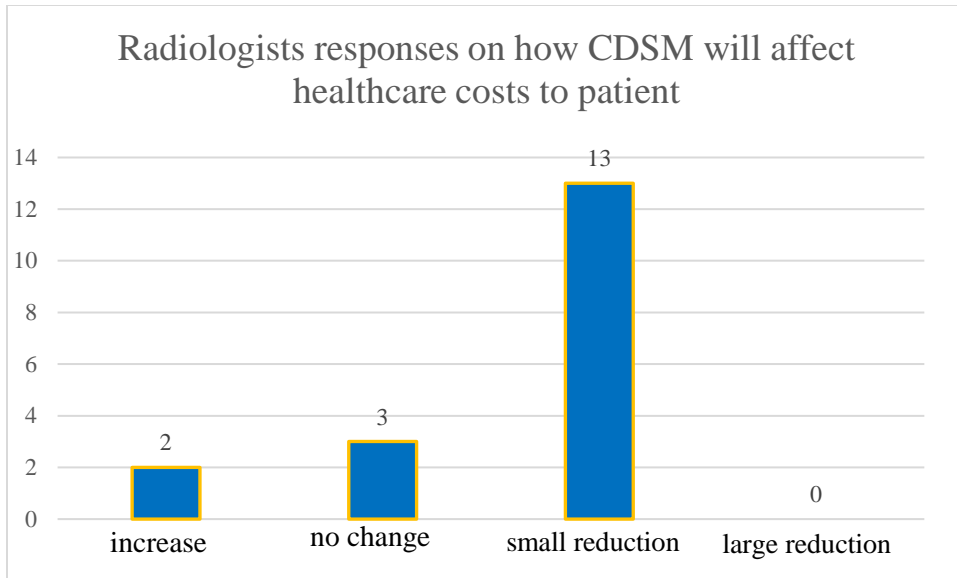
Do you feel that the use of Clinical Decision Support Mechanisms will reduce overall Healthcare in the U.S?





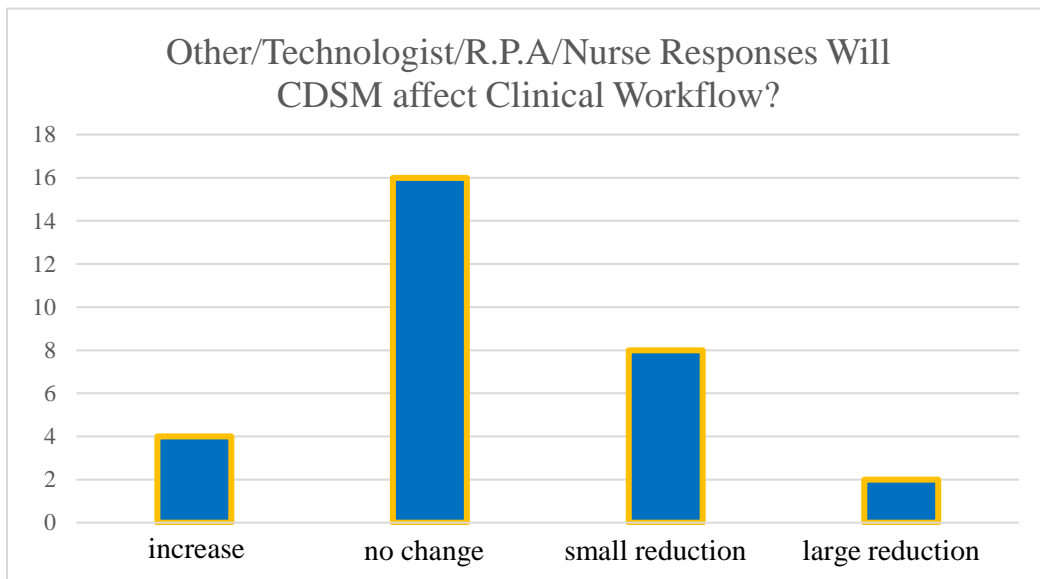
Will CDSM reduce Healthcare costs for patients?

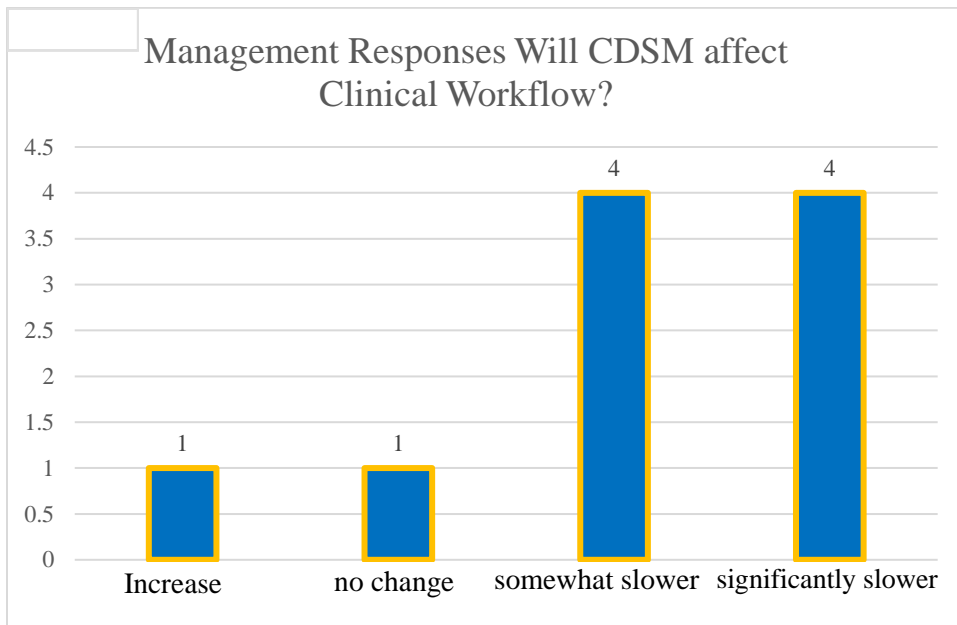
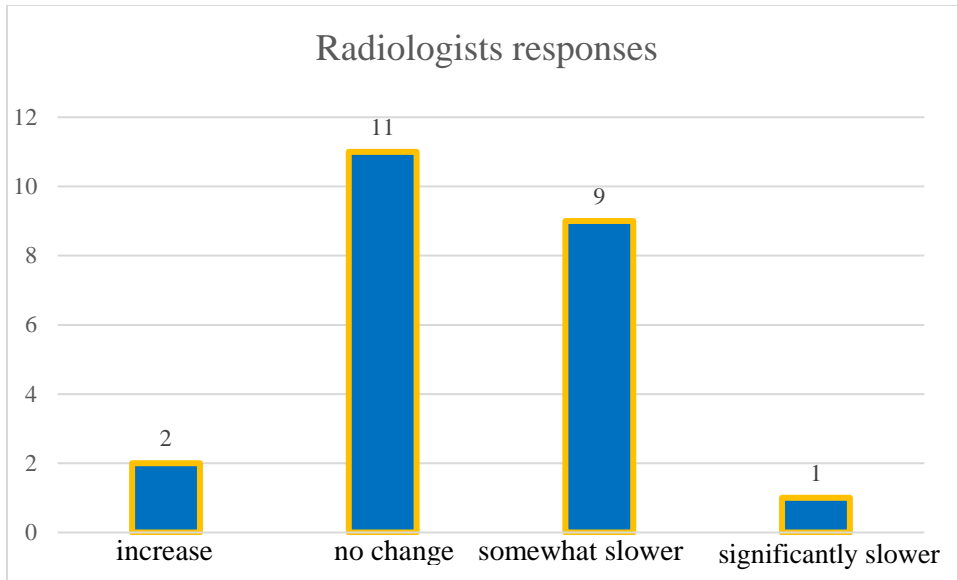




Out of all research participants, seven "other/radiology workers" think that CDSM could increase healthcare costs for the patient.

Are you worried about the use of CDSM slowing down clinical workflow?

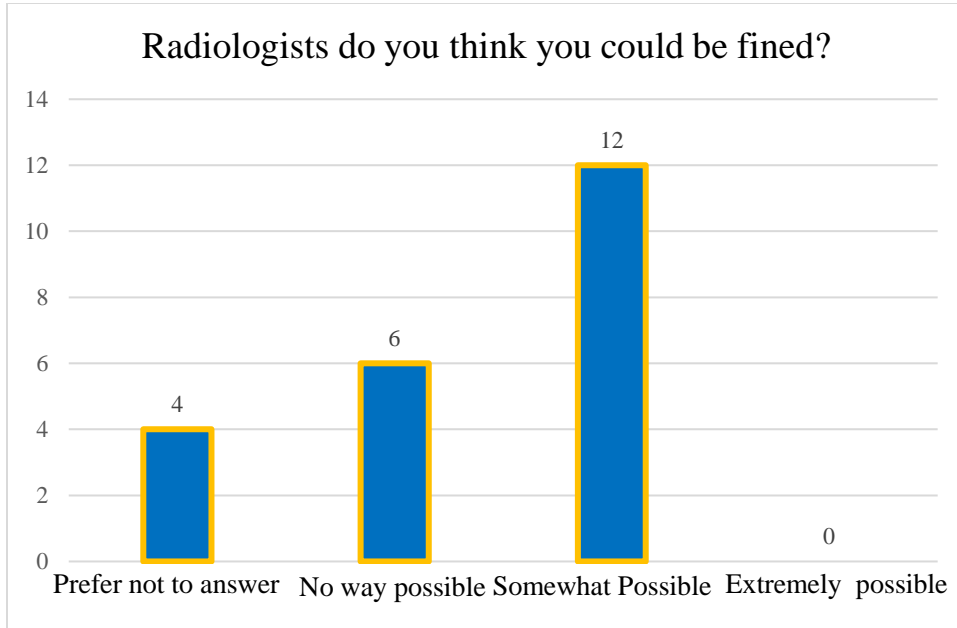




Research participants asked if they believed Clinical Decision Support Mechanisms would affect their clinical workflow. Answers are based on a Likert-type scale ranging from no change, somewhat slower, significantly slower, to an increase in the clinical workflow. Fifty percent of the participants in the study thought their workflow would remain the same. 32.76% of the participants thought CDSM would lessen their workflow. 6.9% thought their workflow would be significantly slower. Only 10.34% believed their workload would increase due to the

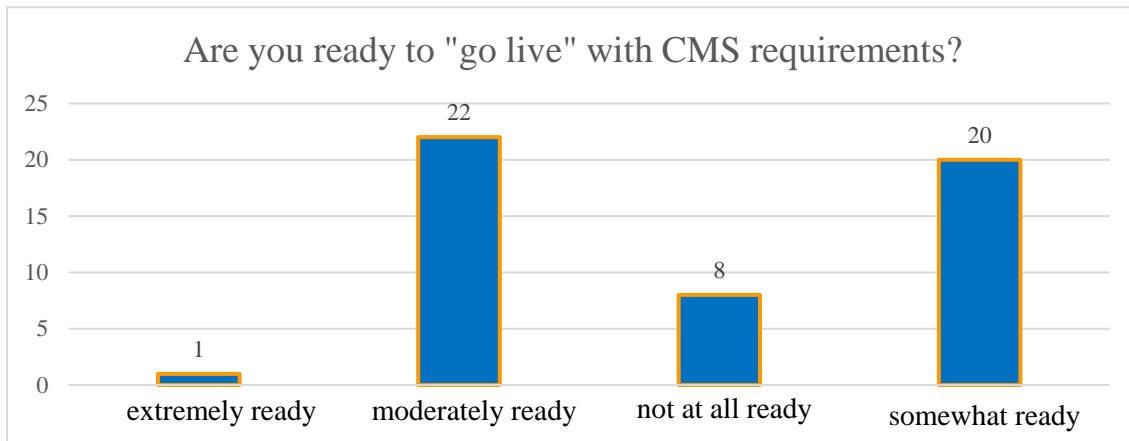
Clinical Decision Support Mechanisms. Research participants were divided into three categories of radiology positions, ranging from radiologists, management, and other/radiologist technologists/RPA/radiology nurses.

When the CMS penalty phase goes live, Radiologists could get fined for not providing the ordering Physician with the correct scan. Will you be fined?



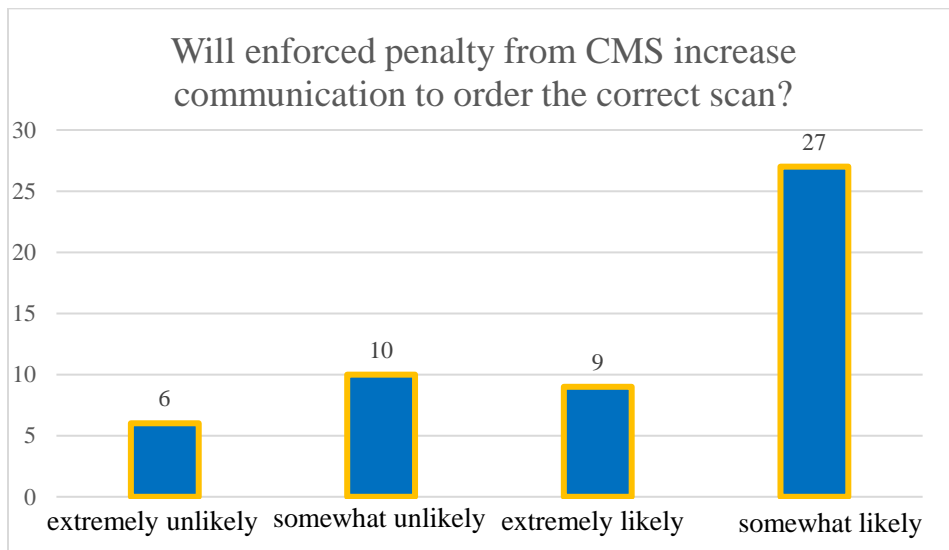
Out of twenty-two responding radiologists, the most common answer was "somewhat possible." Out of twenty-two responding radiologists chose "extremely possible."

The last two years have been a training and operations phase; are radiologists and/or Radiology Departments ready to go live with CMS usage requirements?

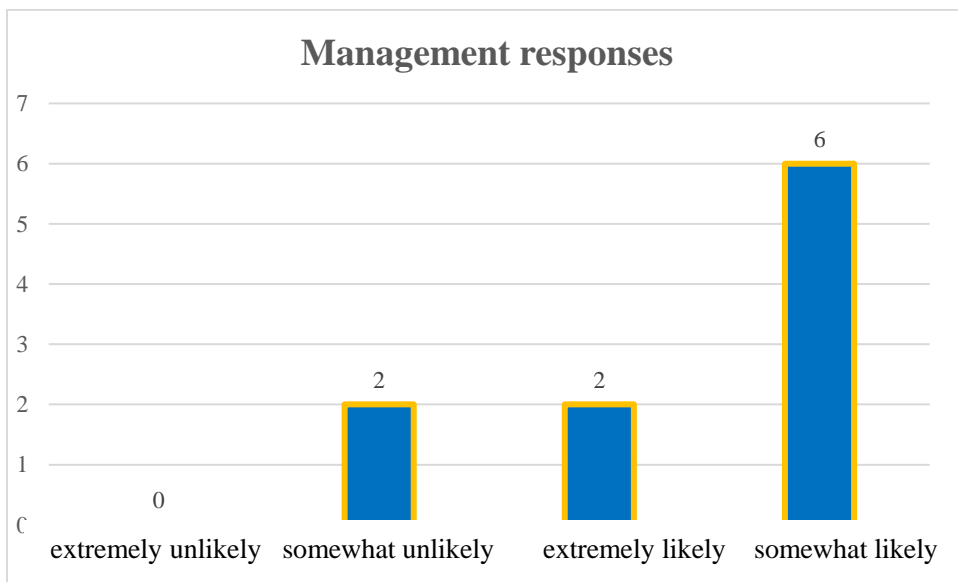
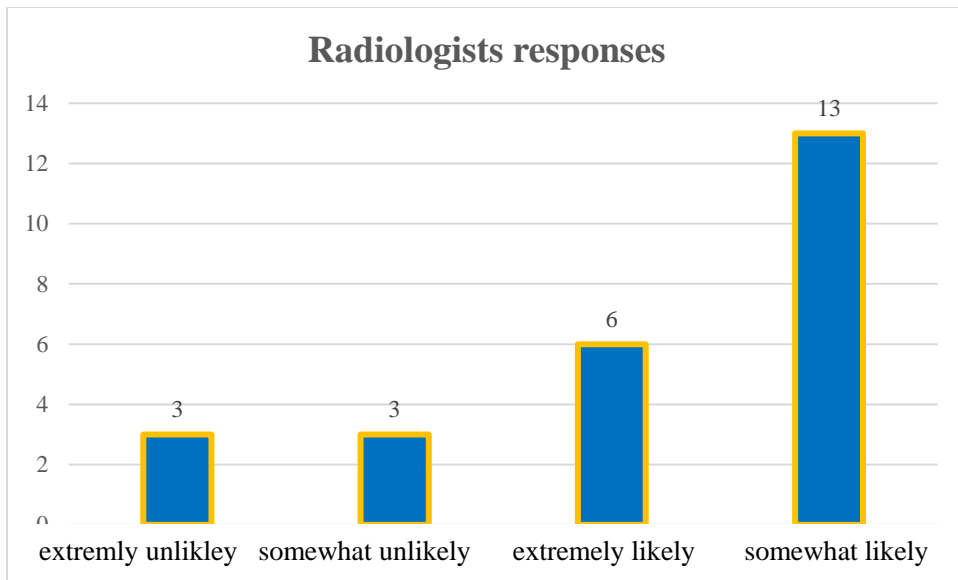


Fifty-one people answered this question. Somewhat ready was chosen twenty-two times at 43.14%. Not at all ready, answered eight times (39.22%). Only one person answered yes to being extremely ready, and eight answered they were moderately ready (15.69%).

Will an enforced penalty from CMS increase communication to order the correct scan?



Out of fifty-two responses, somewhat likely was the most frequent at 51.92%, followed by somewhat unlikely at 19.23%. The graph below shows only Radiologist responses.



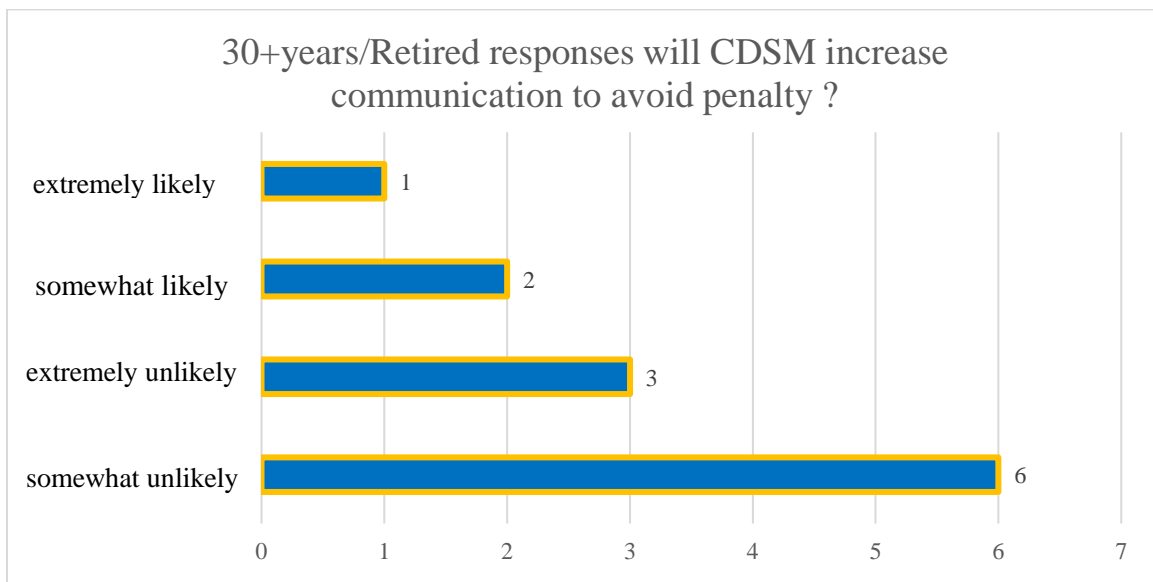
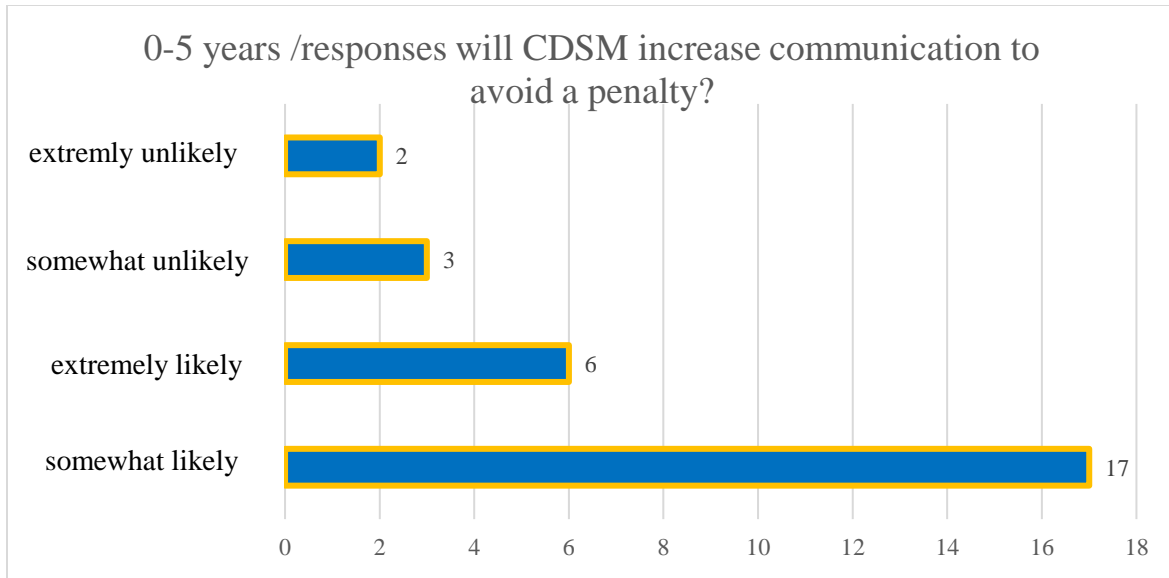
Discussion and Conclusion

According to the collected data, most radiology workers think using Clinical Decision Support Mechanisms will help increase communication and reduce unnecessary scans. The utilization of technology is vital for the future of radiology and takes the “guesswork” out of the radiology study a patient should have. The CMS penalty phase has been in a training and

operations phase over the last four years. The goal of the penalty is to ensure increased communication between and education of ordering physicians and radiologists when choosing the appropriate study. The research discussed in this study shows that radiologists may be significantly affected by the penalty. Many radiologists believe they will not be affected by penalties. Some believe that the penalty phase will never “go-live,” and that the delay phase is indefinite. When participants were asked if they were ready to “go-live,” only eight of fifty-one participants answered that they were not ready. Most participants felt they are at least somewhat ready to “go-live” with the penalty phase.

When participants were asked whether they thought CDSM would increase the clinical workflow in the department, most management personnel answered that CDSM will slow down clinical workflow. Many radiologists, however, answered that they think the use of a CDSM will not change their clinical workflow.

Another significant difference to note is looking at the results for 0–5-year radiology workers vs. 30+ year radiology workers, the majority of 0–5-year workers felt that CDSM will increase communication while many of the 30+ year group feel it is unlikely that CDSM will increase communication. Interestingly, respondents with less experience seemed to choose fewer negative responses. Of course, more experienced radiology workers may be more cynical about changes in their established workflow. A follow-on study done on a much larger group of radiologists with a wider distribution area will provide more reliable and valid data on this topic.



Across all participants, the growing census on will CDSM increase healthcare costs in the U.S, ‘small reduction’ in costs was popular. A ‘small reduction’ was also the most common answer when asked if healthcare costs to the patient would change.

The outcome of this study provides beneficial research on clinical decision support systems and their utilization. ACR-based research has shown when physicians are educated on radiology studies, they order the correct scan, and patients endure less radiation exposure, and

lower healthcare costs. Data collected in this study has shown that some radiologists do not think CDSM will reduce unnecessary scans and many from this study are not worried about the CMS penalty phase to begin. The survey had a small-time window and limited number of responses. Further research with a larger number of radiologists would be beneficial for data-driven discussions and literature on this topic.

References

1. Chepelev, L. L., Wang, X., Gold, B., Bonzel, C. L., Rybicki Jr, F., Uyeda, J. W., Sheikh, A., Anderson, D., Lindaman, J., Mogel, G., Mitsouras, D., Mahoney, M. C., Cai, T., & Rybicki, F. J. (2021). Improved Appropriateness of Advanced Diagnostic Imaging After Implementation of Clinical Decision Support Mechanism. *Journal of Digital Imaging*, 34(2), 397–403. <https://doi.org/10.1007/s10278-021-00433-6>
2. *Clinical Decision Support*. (n.d.). Radiology & Biomedical Imaging. <https://medicine.yale.edu/diagnosticradiology/patientcare/physicians/cds/>
3. Coffta, S. (n.d.). *Medicare's AUC/CDS Mandate Will Begin Next Year*. <https://info.hapusa.com/blog-0/medicares-auc/cds-mandate-will-begin-next-year>
4. Coiera, E., Westbrook, J. I., & Wyatt, J. C. (2005). The safety and quality of decision support systems. *Yearbook of Medical Informatics*, 20–25.
5. Golding, L. P., & Nicola, G. N. (2020). Clinical Decision Support: The Law, the Future, and the Role of Radiologists. *Current Problems in Diagnostic Radiology*, 49(5), 337–339. <https://doi.org/10.1067/j.cpradiol.2020.02.001>
6. Hendel, R. C., MD. (2016, May 1). *Widespread Implementation of Appropriate Use Criteria for Cardiac Imaging—Which Are “Appropriate”?* Cardiology | JAMA Cardiology | JAMA Network. <https://jamanetwork.com/journals/jamacardiology/fullarticle/2505210>
7. Henry J. Kaiser Foundation, Cubanski, J., & Newman, T. (2019). The Facts on Medicare Spending and Financing. <https://collections.nlm.nih.gov/master/borndig/101717009/Issue-Brief-The-Facts-on-Medicare-Spending-and-Financing.Pdf>.

8. Hentel, K. D., Menard, A., Mongan, J., Durack, J. C., Johnson, P. T., Raja, A. S., & Khorasani, R. (2019). What Physicians and Health Organizations Should Know About Mandated Imaging Appropriate Use Criteria. *Annals of Internal Medicine*, 170(12), 880.
<https://doi.org/10.7326/m19-0287>
9. Howell, J. D. (2021a). The CT scan after 50 years — Continuity and Change. *New England Journal of Medicine*, 385(2), 104–105. <https://doi.org/10.1056/nejmp2033374>
10. Hussey, P. S., Timbie, J. W., Burgette, L. F., Wenger, N. S., Nyweide, D. J., & Kahn, K. L. (2015). Appropriateness of Advanced Diagnostic Imaging Ordering Before and After Implementation of Clinical Decision Support Systems. *JAMA*, 313(21), 2181.
<https://doi.org/10.1001/jama.2015.5089>
11. Miglioretti, D. L. (2011, June 1). *Overuse of Computed Tomography and Associated Risks*. AAFP. <https://www.aafp.org/pubs/afp/issues/2011/0601/p1252.html>
12. *More Questions Than Answers on PAMA Regulation Change | AACC.org*. (n.d.).
<https://www.aacc.org/cln/articles/2019/janfeb/more-questions-than-answers-on-pama-regulation-change>
13. Shaikh, F., Dehmeshki, J., Bisdas, S., Roettger-Dupont, D., Kubassova, O., Aziz, M., & Awan, O. (2021). Artificial Intelligence-Based Clinical Decision Support Systems Using Advanced Medical Imaging and Radiomics. *Current Problems in Diagnostic Radiology*, 50(2), 262–267. <https://doi.org/10.1067/j.cpradiol.2020.05.006>
14. Smith-Bindman R, Kwan ML, Marlow EC, et al. Trends in Use of Medical Imaging in US Health Care Systems and in Ontario, Canada, 2000-2016. *JAMA*. 2019;322(9):843–856.
[doi:10.1001/jama.2019.11456](https://doi.org/10.1001/jama.2019.11456)