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Advanced Nurse Practitioner Educational
Needs for Safe and Efficient Radiological Imaging

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Purpose of the Study


To evaluate the knowledge and educational preparedness of advanced practice nurses (APNs) in the area of radiologic imaging.



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Background

- Numerous studies acknowledge need for further physician education on radiological imaging
- Little to no research assessing APNs



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Overuse

- ❑ Over 400 million radiology-imaging studies performed each year in the U.S.
- ❑ U.S. accounts for 4.5% of the world population, 50% of all nuclear medicine procedures
- ❑ Collective dose from medical imaging increased by 700% between 1980-2006



Pediatric Risks

- Exposed to more life time accumulated risks
- More sensitive to radiation exposure
- Pediatric Protocols- "Image Gently"



Costs

- ❑ 20% of U.S. GDP spent on health care (Neiman Report, 2012)
- ❑ \$100 billion spent annually on diagnostic imaging in the U.S. (Otero, Rybicki, Greensberg, & Neumann, 2008)



Average Effective Radiation Doses

- Angiography of Chest (Coronary)= 1,231 chest x-rays.
- Angiography of chest(Pulmonary)= 1,154 chest x-rays
- Myocardial perfusion imaging = 2,231 chest x-rays
- Transjugular intrahepatic portosystemic shunt placement= 5,385



Radiology Knowledge Survey

- Survey developed by investigator to evaluate perception of knowledge in the area of radiology.



Sample

- Met inclusion criteria- graduated from an accredited APN program.
- 107 different Universities identified and 20 different States.
- Median practice years- 11.48



Clinical Questions

- Are APNs practicing in the state of Florida familiar with the ACR-AC?
- Are there differences between respondents based on their years of experience?
- Are there differences between respondents based on their educational preparation?



Familiarity with the ACR-AC

- Majority were not aware of the ACR-AC (n=681; 75.9%)
- Majority do not utilize ACR-AC in practice (n=692; 76.8%)



What is the ACR-AC?

- American College of Radiology Appropriateness Criteria
- Evidence-based guidelines developed and reviewed every two years by expert multidisciplinary panel
- Recommendations for appropriate imaging and treatment of specific conditions for radiologists and referring practitioners (ACR, 2013).



ACR - Website

[http://www.acr.org/Quality-Safety/
Appropriateness-Criteria](http://www.acr.org/Quality-Safety/Appropriateness-Criteria)



American College of Radiology – Appropriateness criteria

- [http://www.acr.org/~media/ACR/
Documents/AppCriteria/Diagnostic/
AcuteTraumaKnee.pdf](http://www.acr.org/~media/ACR/Documents/AppCriteria/Diagnostic/AcuteTraumaKnee.pdf)



Mammography

- [http://www.acr.org/~media/ACR/
Documents/AppCriteria/Diagnostic/
BreastCancerScreening.pdf](http://www.acr.org/~media/ACR/Documents/AppCriteria/Diagnostic/BreastCancerScreening.pdf)



American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: Acute Head and Neck Trauma
Variant 1: Wrist trauma, first exam.

Radiologic Procedure	Rating	Comment	EBL*
X-ray wrist	9	Including at least a PA, lateral, and posteroanterior oblique. Significant oblique views may increase yield for distal radius fractures, especially when added for ulnar-sided pain.	Min
CT wrist without contrast	2		Min
MRI wrist without contrast	2		None
NUC Tc-99m bone scan wrist	2		Med
US wrist	1		None

Rating Scale: 1-Least appropriate, highest appropriate. *Relative Radiation Level

Variant 2: Suspect acute distal radius fracture. Radiograph normal. Next procedure.

Radiologic Procedure	Rating	Comment	EBL*
Chest and repeat x-ray wrist in 10-14 days	4		Min

Date of origin: 10/0
Last revised: 06/2011

Differences based on years in practice

- Statistically significant differences in ordering radiological imaging in the areas of pulmonary, vascular, gastrointestinal, breast, genitourinary, molecular, neurological studies, and head and neck

Table 3.2 ANOVA: Confidence in ordering diagnostic imaging

		ANOVA			F	Sig.
		Sum of Squares	df	Mean Square		
Interventional	Between Groups	1.789	1	1.789	.739	.390
	Within Groups	2163.556	893	2.423		
	Total	2165.345	894			
Pediatric	Between Groups	2.251	1	2.251	.832	.362
	Within Groups	2423.376	895	2.708		
	Total	2425.628	896			
Neuro	Between Groups	.023	1	.023	.911	.917
	Within Groups	1912.330	893	2.141		
	Total	1912.353	894			
MSK	Between Groups	.290	1	.290	.200	.655
	Within Groups	1300.388	895	1.453		
	Total	1300.678	896			
HN	Between Groups	25.482	1	25.482	16.373	.000
	Within Groups	1386.713	891	1.556		
	Total	1412.195	892			
Neur	Between Groups	17.530	1	17.530	9.990	.002
	Within Groups	1558.793	886	1.755		
	Total	1576.323	887			
MS	Between Groups	28.242	1	28.242	19.928	.000
	Within Groups	1261.310	890	1.417		
	Total	1289.552	891			
GU2	Between Groups	33.111	1	33.111	20.698	.000
	Within Groups	1428.232	893	1.600		
	Total	1461.343	894			
GI	Between Groups	13.404	1	13.404	9.126	.003
	Within Groups	1305.689	889	1.469		
	Total	1319.093	890			
vasc	Between Groups	17.125	1	17.125	10.089	.002
	Within Groups	1517.113	894	1.697		
	Total	1534.238	895			
card	Between Groups	4.954	1	4.954	3.102	.079
	Within Groups	1426.442	893	1.597		
	Total	1431.397	894			
pul2	Between Groups	12.387	1	12.387	10.369	.001
	Within Groups	1059.667	887	1.195		
	Total	1072.054	888			
breast	Between Groups	37.128	1	37.128	21.016	.000
	Within Groups	1563.465	885	1.767		
	Total	1600.593	886			

(continued on next page) mean rank 427.62. Mann-Whitney U = 10111.500, z = -2.298, Sig. = .023

Differences based on specialty

- Familiarity compared among primary and acute specialties
- T- test results show no statistically significant differences between groups
- Acute care reported greater perceived competency in ordering imaging studies within their specialty and use of contrast after graduation from APN program



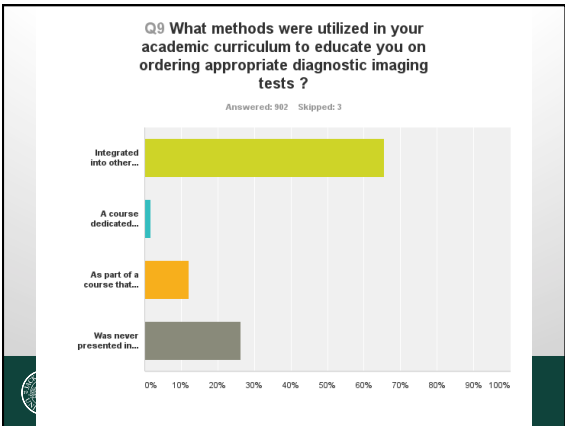


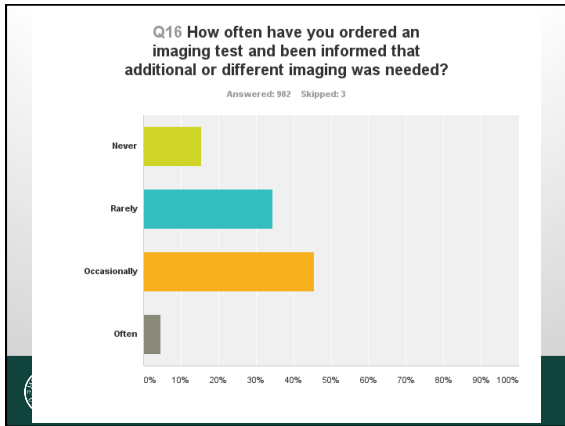
Table 4.1. (4.6)ANOVA: Perceived competency on program completion acute vs. primary care APNs

		Sum of Squares	df	Mean Square	F	Sig.
Competency common condition	Between Groups	7.606	1	7.606	9.023	.003
	Within Groups	731.669	868	.843		
	Total	739.275	869			
Competency ultrasound, MRI, nuclear	Between Groups	1.131	1	1.131	1.451	.229
	Within Groups	676.695	868	.780		
	Total	677.826	869			
Understand the risk of radiation exposure	Between Groups	3.318	1	3.318	3.490	.062
	Within Groups	819.265	862	.950		
	Total	822.582	863			
Competency in interpreting dx report	Between Groups	5.930	1	5.930	7.070	.008
	Within Groups	723.601	863	.838		
	Total	729.531	864			
Competency in ordering contrast	Between Groups	10.748	1	10.748	14.800	.000
	Within Groups	626.597	866	.724		
	Total	637.346	867			
Competency in ordering best test	Between Groups	2.481	1	2.481	2.990	.084
	Within Groups	717.175	865	.829		
	Total	719.656	866			

P < .05 in the areas of common conditions ordered in specialty, interpreting diagnostic reports, competency in ordering contrast.









Study Results Summary

- ❑ Estimated response rate of 12.69% (n=905)
- ❑ 75.9% (n = 684) had never heard of ACR-AC
- ❑ Experience increased perceived competency
- ❑ Acute care better perceived knowledge of:
 - interpretation of imaging results
 - ordering diagnostic imaging specific in their specialty
 - use of contrast agents

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Results cont.

94.89% said they would like continuing education the area of radiology
92.3% said they would like to have had radiology incorporated into their educational program.

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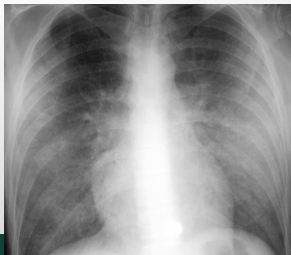
Assuming that imaging is clinically necessary

- Decide what to order
- Decide how to Order




Choosing a study

- Comparative studies
- Consensus
- Usefulness
- Do no harm
- Availability
- Expense
 - patient
 - system



Use your Radiologist

- Think of Radiologist as a consultant
- Invest time and effort
- Help them help you
- Summarize signs/symptoms/history
 - Tell them what you want to know
 - ICD9 (so they can bill)



Use of Clinical Decision Aides

- National Emergency X-Radiology Utilization Study(NEXUS), Canadian Cervical Spine Rule, Ottawa Foot and Ankle Rules, Pediatric head CT rule, and Pulmonary Embolism Rule-Out Criteria(PERC).



On the Menu:

- Plain Films
- Fluoroscopy
- Ultrasound
- CT (Computerized Tomography)
- MRI (Magnetic Resonance Imaging)
- Nuclear Medicine/PET CT
- Angiography



Plain Radiographs

- Includes:
 - CXR
 - Abdominal series
 - Musculoskeletal imaging etc
- Ordering basics involve what type of views you need
 - ie. A knee series can be an AP only or as many as 5 views



Plain Films

- Economical
- Readily available
- Quick
- Informative
- Good place to start



Chest X-Ray

- Radiological investigation of a Chest problem should always start with a CXR
- Varieties: AP, PA & lateral, decubs
- PA & lateral: best quality
- AP: standby for immobile patients, portable studies
- Decubs: eval pleural effusion



Views

- Understand the view in which your xray is taken.
- AP vs PA/ lateral



KUB & Abd series

- KUB: supine abdominal film
 1. Evaluation for obstruction (Used primarily)
 2. Abnormal calcifications (kidney stones)
- Abd series: KUB, upright chest, +/- decubs
 1. Obstruction
 2. Calcifications
 3. Pneumoperitoneum
- Further eval: CT



Extremity Films

- Good for broken bones, lesions
- Very limited Soft Tissue info: effusions, sq emphysema, foreign bodies
- For better definition of bone: CT
- For better definition of soft tiss: MRI
- For foreign bodies: CT or US



Bone

- Plain films are more valuable than MRI for bone problems!

(Known limitations: osteomyelitis, stress fractures, etc)



Fluoroscopy

- GI studies-Patient must be able to drink barium or gastrograffin
- Esophagrams vs. Barium swallow
 - Barium enema
 - Pouchograms/fistulograms
- Orthopedic Surgery-
 - Guide fracture reduction
- Angiography -
 - Leg , heart and cerebral vessels



Ultrasound

- Includes many different exams
 - Thyroid
 - HBP, Abdominal duplex
 - Gallbladder
 - Pelvic
 - Testicular
- Sometimes better than other studies, particularly for blood flow states
- Limitations: body habitus, bowel gas
 - I.e. we use acoustic windows



CT-computed tomography

- CT exams include
 - Head (w/ vs. w/o contrast)
 - Neck
 - Chest
 - Abdomen/pelvis
 - Musculoskeletal
- Type of contrast administration depends on what you are looking for.



Contrast

- Use contrast to assess vascular pathology, abscess or neoplasm (known or suspected) should be performed with IV contrast if possible.
- Contrast- Oral separates bowel from pathology
- IV gives enhancement to all perfused organs and vessels.



CT protocols

- Noncontrast:
 - Head CT
 - Renal stone protocol
 - Allergy to contrast
 - Low GFR
- Contrast:
 - Oral, separates bowel from pathology
 - IV, gives enhancement to all perfused organs as well as vessels



MRI-magnetic resonance imaging

- MRI includes
 - Neuro studies
 - Musculoskeletal studies
 - Vascular studies
 - Abdomen, pelvic floor



IV contrast Reactions

- Allergic
 - Hives, laryngeal edema, bronchospasm, pulmonary edema, bradycardia, HTN, seizures, hypoglycemia, cardiac arrest
- Renal failure
 - ATN



Nuclear Imaging

- Gamma ray imaging systems used to detect radiation emitted from the patient




Nuclear Imaging Common Uses

- Ventilation and Perfusion lung imaging for diagnosis of pulmonary embolism
- Hepatobiliary imaging
- Skeletal Imaging- Bone Scan metastatic lesion, osteomyelitis
- ACE inhibitor renal scan
- Myocardial Perfusion Imaging



Positive Emission Tomography


- Highly sensitive for small tumors that may be missed on MRI or CT scans.
- Neurologic-
- Diagnosis of various brain disorders dementia, depression , schizophrenia, epileptogenic foci
- Cardiac Imaging
- Myocardial viability



Give clear clinical data


Poor example of an order for an abd/pelvis CT

- Diagnostic Question: R/O malignancy
- History: Constitutional Symptoms



Don't use "Rule Outs"

- Take radiologist down the wrong path
- Make radiologists second-guess you
- Make Radiologists waffle (cannot prove a negative)
- Really bad NPV
 - Limitations of technique (search)
 - "The hardest thing to find is the one that's not there"
 - Radiologist do not get paid with a rule out diagnosis.



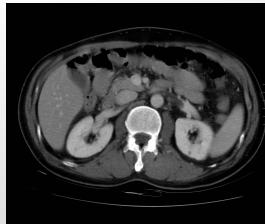
General CT considerations

- Quick
- Available
- Relatively Affordable
- Problems:
 - Radiation (children, pregnancy)
 - Patient Size limit 450 lb
 - Patient Motion
 - Pt with ESRD



CT IV Contrast

- Benefits:
 - Better contrast in soft tissues
 - Better delineation of tissue types
 - Better sensitivity for tumors/abscesses
- Risks
 - Kidney damage (eGFR < 60)
 - Allergic reactions
 - Fluid overload



Allergic Reactions

- Hx of life-threatening reactions is an absolute contraindication for contrast
- Important to know if pt has had prior reaction to intravenous contrast- screen pt for allergies!
- True allergy- anaphylactic (Type I reactions) or mild (delayed Type 4).
- For mild reactions: premedicate
 - Call CT for protocol x8069



Terminology

Consolidation – Can be anything that's denser than the lung

- Cancer
- Fluid
- Atelectasis
- Pneumonia



Infiltrate

A nonspecific and imprecise term.
Any poorly defined opacity in the lung



What to do with results

- Understand when additional imaging is needed.
- Is surgery indicated?
- Antibiotics
- Specialty consultation ?



Summary

- Radiological imaging has grown in its usefulness towards clinical diagnosis.
- Understanding how and what to order is complicated and APN's need more educational preparation and awareness in this area.



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