Improving Pediatric Breast Ultrasound Reporting and Recommendations: A Quality Improvement Initiative

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*The Association for Medical Imaging Management (AHRA)

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Pediatric Breast Imaging

- Breast masses are uncommon in the pediatric population
  - Frequently cause considerable concern for the patient and their parents
- Ultrasound (US) is the preferred imaging modality
  - Lack of ionizing radiation
  - Adequate tissue characterization
  - Easy availability
- Mammography is not advised in children
  - Low incidence of malignancy
  - Risk of radiation to the immature glandular tissues
  - Poor lesion conspicuity in dense fibroglandular breasts

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Pediatric Breast Ultrasound

- At CHLA, pediatric breast ultrasound is reviewed by pediatric radiologists
- Recommendations are generally based on individual experience and practice
  - No formal guidelines, consensus or recommendations for management of imaging findings on pediatric breast ultrasound
- Inconsistent recommendations can confuse clinicians
  - May lead to additional, unnecessary imaging, procedures, and/or surgery

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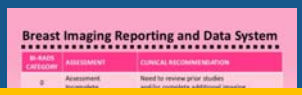
Current Practices

- Breast Imaging-Reporting and Data System (BI-RADS) is a widely used risk assessment and quality assurance tool
  - Mammography, ultrasound or MRI
  - Developed for adult women



What are the current recommendations for pediatric breast ultrasound?

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Goals

- To find or establish literature based guidelines for recommendations based on common pediatric breast US findings
  - Can BI-RADS be used in the pediatric population?
- To consistently offer standardized recommendations for common pediatric breast US findings
  - What are the current recommendations for the pediatric population?
- To stop routinely encouraging further imaging
  - Recommend further imaging only when clearly indicated
  - Avoid routine recommendations such as "Follow up with dedicated imaging at Women's Imaging Center" or "Consider breast MRI"

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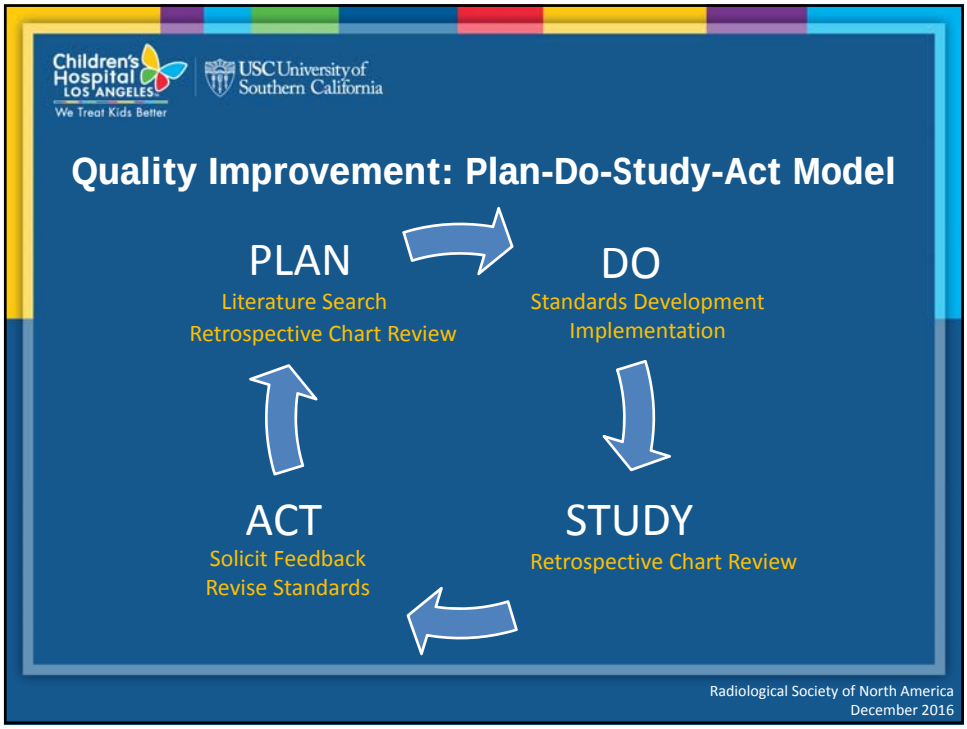
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Quality Improvement: Plan-Do-Study-Act Model
PLAN
Literature Search
Retrospective Chart Review
DO
Standards Development
Implementation
STUDY
Retrospective Chart Review
ACT
Solicit Feedback
Revise Standards
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Quality Improvement: Plan
PLAN
Literature Search
DO
STUDY
ACT
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Literature Search

- To build evidence for our initiative, we performed a search of the current scientific literature to establish best practices
- Specifically, we searched the literature for:
  - Appropriateness of applying BI-RADS to the pediatric population
  - Current recommendations for ultrasound findings specific to the pediatric population
- Pubmed database was queried with the following search terms on 7/21/15
  - Pediatric, breast ultrasound, BI-RADS

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BI-RADs in Pediatric Breast Ultrasound

Contents lists available at ScienceDirect

Journal of Pediatric Surgery

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Original Article

Breast Imaging-Reporting and Data System (BI-RADS) classification in 51 excised palpable pediatric breast masses☆,☆☆

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Koning, et al

- Retrospective review of all surgically excised breast masses* at a single tertiary care pediatric hospital (UCSD) between July 2010 and November 2013
- Patients** with preoperative breast ultrasound and a BI-RADS-US classification were selected.
  - Clinical notes, laboratory data, and surgical pathology reviewed via EMR
- Surgical pathology reports were used for correlation of BI-RADS classification

* Patients operated on for gynecomastia or breast abscess were excluded
**Postmenarchal females age 15-19

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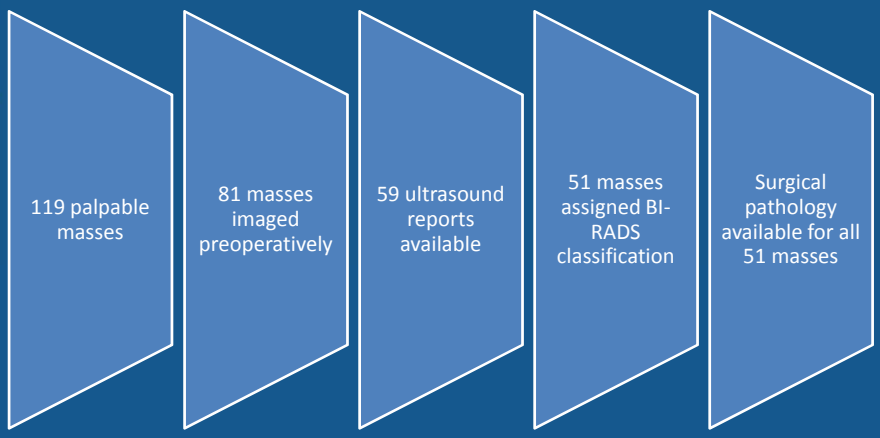
Study Population



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BI-RADS US Classification

Table 2
BI-RADS US categories in 51 masses with surgical pathology.

BI-RADS US category	Number of masses ($n = 51$)
BI-RADS 0	2 fibroadenoma
BI-RADS 2	5 fibroadenoma, 1 myxoid fibroadenoma, 1 juvenile fibroadenoma
BI-RADS 3	15 fibroadenoma, 1 fibroadenoma with PASH[a], 1 PASH[a]
BI-RADS 4	21 fibroadenoma, 3 tubular adenoma, 1 fibrocystic change

[a] PASH—pseudoangiomatous stromal hyperplasia.

No masses were assigned BI-RADS category 5 or 6

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Pathologic Classification of Excised Masses

Table 3
Surgical pathology in 119 palpable pediatric breast masses.

Surgical pathology	Number of masses—n (% of 119)
Conventional fibroadenoma	84 (70.6%)
Juvenile fibroadenoma	7 (5.9%)
Tubular adenoma	5 (4.2%)
Fibroadenoma with PASH[a]	3 (2.5%)
Other[b]	20 (16.8%)
Total	119 (100%)

[a] Pseudoangiomatous stromal hyperplasia.
[b] Other masses—supernumerary nipple ($n = 3$), myxoid fibroadenoma ($n = 2$), fibrocystic change ($n = 2$), benign cyst ($n = 2$), ductal ectasia ($n = 2$), hamartoma ($n = 2$), fibroadenoma with necrosis ($n = 2$), PASH ($n = 1$), galactocele ($n = 1$), fibrosis ($n = 1$), chronic lymphocytic mastitis ($n = 1$), and vascular malformation ($n = 1$).

All masses were found to be benign on pathology

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Conclusions

- BI-RADS was developed to assess risk of malignancy in adult patients and to communicate the risk of malignancy
  - It has been increasingly applied to US performed on pediatric patients and adolescents
- Authors noted that management of a BI-RADS 4 classification is significantly different from a BI-RADS 3 classification
  - Likely resulting in biopsy of masses that could have been managed with observation
- Concluded that BI-RADS classification overstates the risk of malignancy in the pediatric and adolescent population

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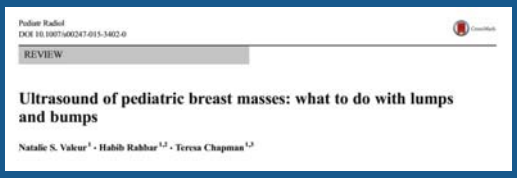
Pediatric Breast Ultrasound Recommendations


Pediatr Radiol
DOI 10.1007/s00247-015-3402-0
REVIEW
Ultrasound of pediatric breast masses: what to do with lumps and bumps
Natalie S. Valeur · Habib Rahbar · Teresa Chapman


European Journal of Radiology
Review
How to approach breast lesions in children and adolescents
Yiming Gao, Mansi A. Saksena, Elena F. Brachtel, Deborah C. terMeulen, Elizabeth A. Rafferty

Current recommendations for ultrasound findings specific to the pediatric population from Pediatric Radiology and European Journal of Radiology

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Valeur, et al

Table 2 Summary of appropriate differential diagnoses and clinical recommendations for diagnosis of pediatric breast masses

Clinical situation	Differential diagnosis	Recommendation
Neonate or young child	• Physiological response to maternal hormones • Gynecomastia	• Do not biopsy, clinical follow-up is sufficient • If vascular, likely hemangioma
Simple cystic mass	• Must demonstrate the following features: unilocular, well-circumscribed, anechoic, posterior acoustic enhancement • If any internal debris or vascularity is present, refer to complex cystic mass	• Most commonly no treatment or follow-up is necessary. Aspiration could be pursued for significant pain or to confirm liquid contents if sonography is confused by internal debris/complexity
Duct ectasia		• Observe and culture nipple discharge. Likely to resolve spontaneously
Complex cystic mass	• Abscess • Hematoma/fat necrosis • Galactocele	• Aspiration, consider follow-up US
Adolescent with breast mass <5 cm, benign US features	• Most likely fibroadenoma • Less likely PASH, phyllodes tumor	• US follow-up • If stable for 2 years, clinical follow-up • If growing or painful→core biopsy and referral to breast surgeon
Adolescent with breast mass >5 cm, benign US features	• Giant fibroadenoma • Phyllodes tumor	• Surgical consultation for anticipated surgical excision. Lesions of this size cannot be distinguished by needle tissue sampling
Breast mass with irregular shape, angular margins, shadowing or in setting of personal cancer	• Malignancy • Abscess • PASH • Galactocele • Fat necrosis	• Tissue sampling or surgical excision
Any solid or complex cystic mass in setting of prior/known cancer or prior radiation therapy to breast tissue	• Metastasis is the primary concern	• Tissue sampling or surgical excision

PASH pseudoangiomatous stromal hyperplasia

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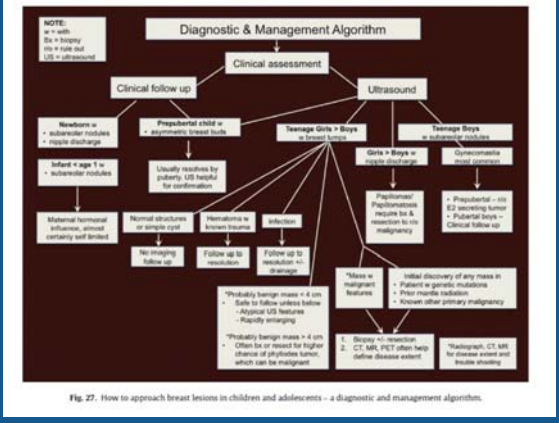

Fig. 27. How to approach breast lesions in children and adolescents – a diagnostic and management algorithm.

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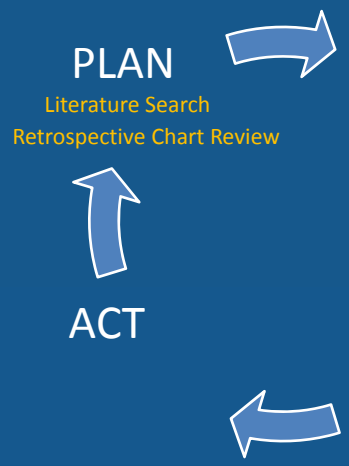
Quality Improvement Project: Plan



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Pathologic Correlation

- We reviewed all breast ultrasounds performed at CHLA from 2013-2015
- Nine breast masses with pre-operative ultrasound imaging were surgically excised from 2013-2015

Pathology	No. of Cases
Juvenile fibroadenoma	6
Phyllodes	1
Tubular adenoma	1
Gynecomastia	1

Benign pathology was consistent with that published in the literature (Koning, et al)

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Quality Improvement: Do

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Development of Standards

- Recommendations from the literature were synthesized into a chart
  - Organized by age and common ultrasound findings
- Recommendations underwent interdisciplinary review, with subsequent revision to reflect expert feedback
  - Board certified radiologist with fellowship training in Women's Imaging
  - Board certified surgeon with fellowship training in Pediatric Surgery

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Standard Recommendations

Age	History/Physical Exam	Imaging	DDx	Recommendations
Neonate	Nipple Discharge	Not necessary	Response to maternal hormones	Clinical follow-up
Neonate-infant	Subareolar nodules	Not necessary	Gynecomastia	Clinical follow-up
Pre-pubertal	Asymmetric breast tissue	Normal breast tissue, duct ectasia, cystic change	Asymmetric breast buds	Clinical follow-up with optional initial ultrasound
Pubertal-Post pubertal	Palpable lump	Simple cyst or normal breast tissue	Simple cyst or breast tissue	Initial ultrasound, but no further imaging required
		Complex cyst or cystic mass	Hematoma, galactocele, abscess	Imaging follow-up to resolution +/- drainage for abscess
		Mass < 4 cm with benign features[1]	Fibroadenoma, PASH, Phyllodes tumor	US follow-up for up to 2 years, then clinical follow-up if stable[2]
		Mass > 4 cm with benign features[1]	Giant Fibroadenoma, Phyllodes tumor	Surgical consultation (excision)
		Any size with suspicious features[2,3]	Neoplasm including malignancy, abscess, PASH, fat necrosis, galactocele	Tissue sample or refer for surgical consultation (excision)
		Any size or features in setting of cancer or prior radiation therapy to breast tissue	Metastasis	Tissue sample or refer for surgical consultation (excision)
Pubertal-Post pubertal	Breast discharge with benign features[4]	Duct Ectasia	Physiologic, debris, papilloma or papillomatosis	Culture fluid and clinical follow-up
Pubertal-Post pubertal	Breast discharge with suspicious features[5]	Intraductal mass or mass with intraductal extension	Clot, debris, ductal carcinoma in situ (DCIS), papilloma, intracystic papillary carcinoma	Tissue sample or refer for surgical consultation (excision)
Pubertal-Post pubertal	Subareolar nodules (Boys)	Normal breast tissue	gynecomastia	Clinical follow-up

[1] Benign features: lack of malignant findings, circumscribed margins, parallel orientation , ellipsoid, thin echogenic psudocapsule
[2] Stable: No increase in size or change in symptoms. If increase in size or painful, do CNB or refer to surgery
[3] Suspicious features: Irregular shape, angular margins, non-parallel orientation, posterior shadowing, associated calcifications, wide trasition zone, increased malignancy risk
[4] Benign features: Bilateral, multiple ducts, spontaneous or stimulated, milky, green, yellow
[5] Suspicious features: Unilateral, uniorificial, bloody, clear, spontaneous

Literature based, standardized recommendations were developed for common ultrasound imaging findings at CHLA

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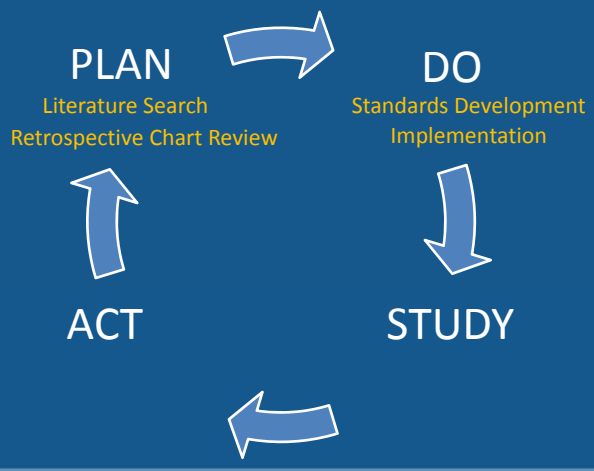
Quality Improvement: Do



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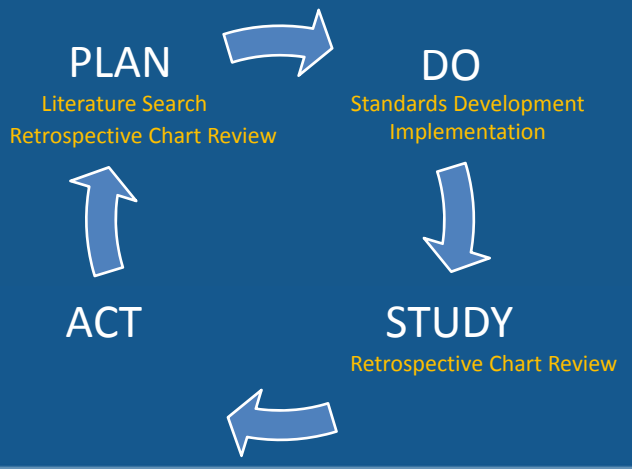
Standards Implementation

- Standardized recommendations were implemented January 11, 2015
  - Literature review results and standardized recommendations were presented to the radiology staff at a department-wide journal club
  - Feedback on the recommendations was solicited
- The standardized recommendations were electronically disseminated to the radiology staff for future reference
- Periodic feedback from the radiology staff was solicited at 3 month intervals

Quality Improvement Project



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Breast Ultrasound Recommendations: Pre-intervention

- Retrospective analysis of the recommendations provided on the 76 diagnostic breast ultrasounds performed from 2013-2015
  - 9 examinations were discarded, as the standard recommendations were not applicable to the ultrasound findings
- Standard recommendations were compared to the recommendations provided on the remaining 67 pre-intervention ultrasounds
  - 35 (52%) of the examinations were found to have recommendations consistent with developed standard recommendations

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Breast Ultrasound Recommendations: Post-Intervention

- 57 ultrasounds performed from 1/11/2016-9/11/2016
  - 3 examinations were discarded, because the standard recommendations were not applicable to the ultrasound findings
- Standard recommendations was applied to the remaining 54 post-intervention ultrasounds
  - 46 examinations (85%) had recommendations consistent with the standard recommendations

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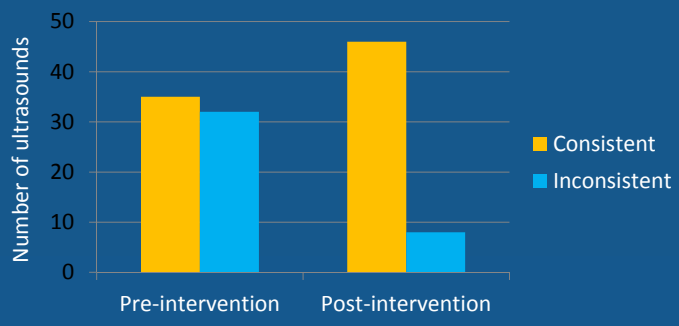
Pre-Intervention vs Post-intervention



Following intervention, the number of recommendations consistent with the literature-based standard recommendations increased from 52% to 85%

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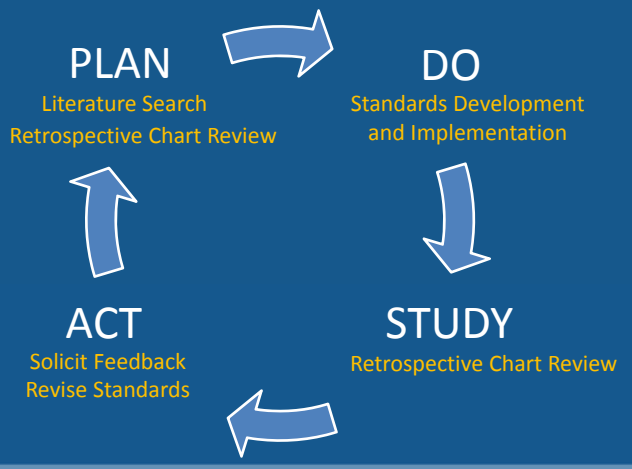

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Future Directions

- Ongoing chart review
- Solicit practice feedback
- Further refine algorithm

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