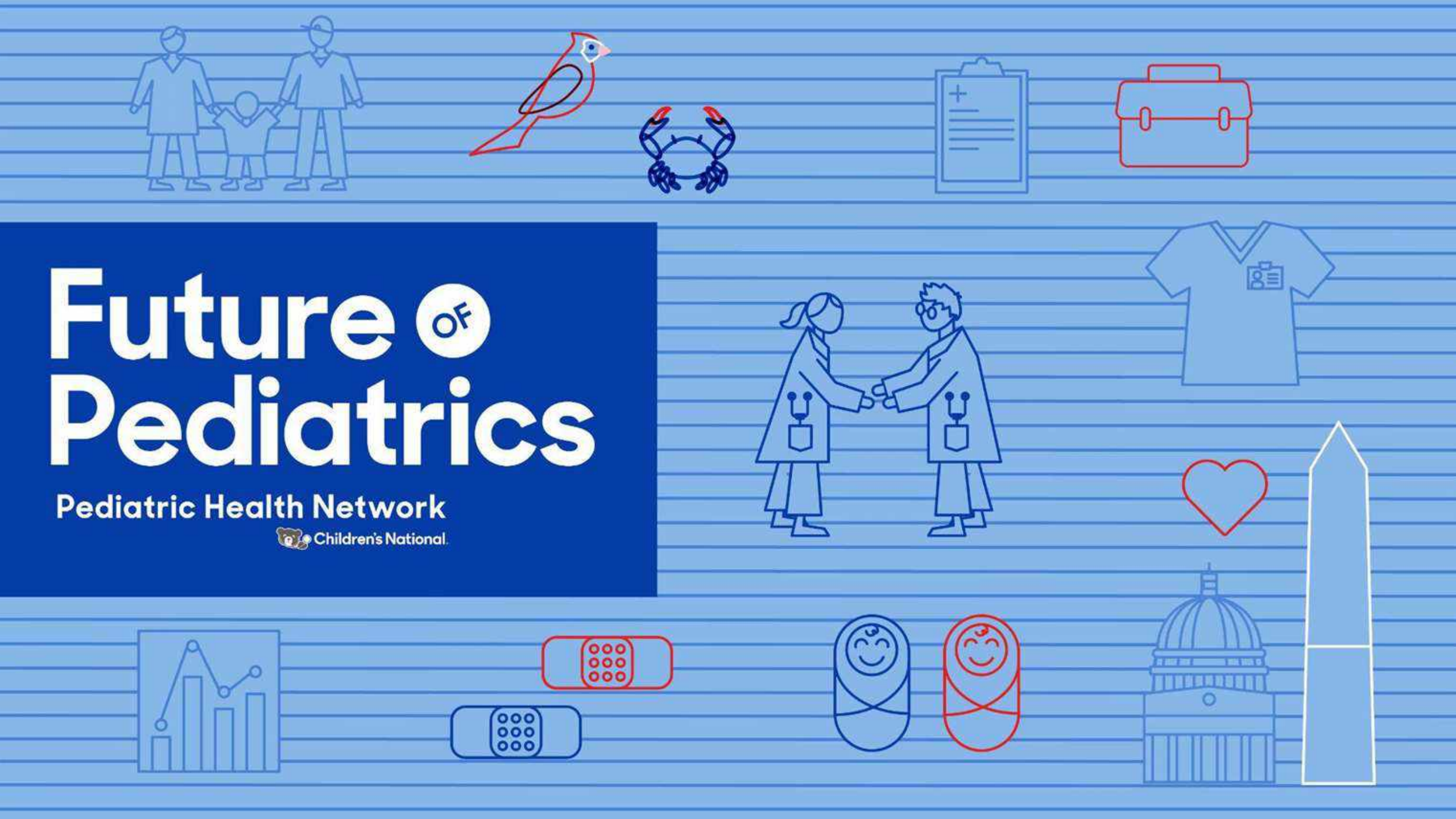
Future OF Pediatrics
Pediatric Health Network
Children's National

Chest Pain in Children:
To Refer or Not to Refer?

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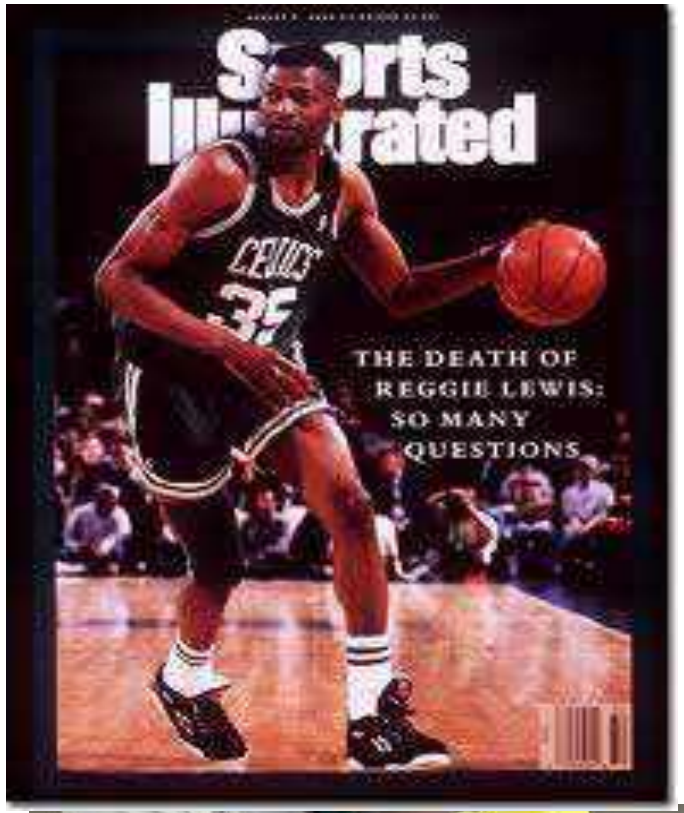
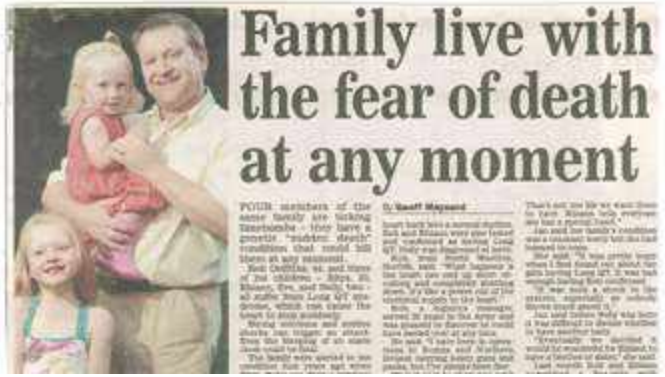
Disclosures

No financial disclosures to report



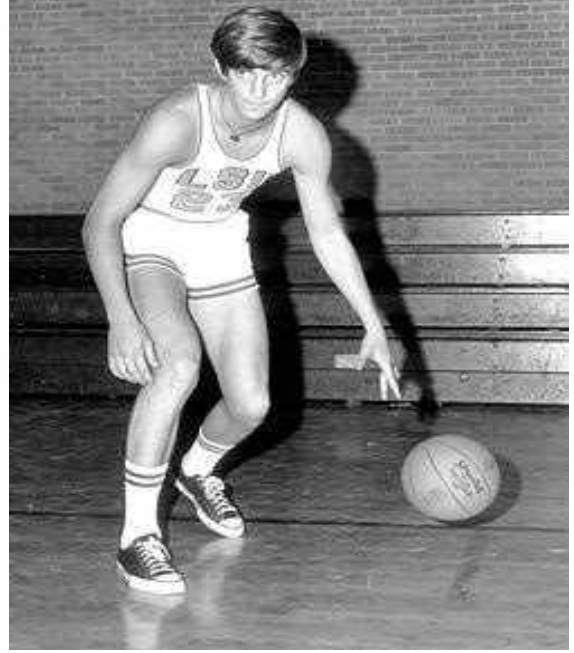


Family live with the fear of death at any moment

By Geoff Maynard

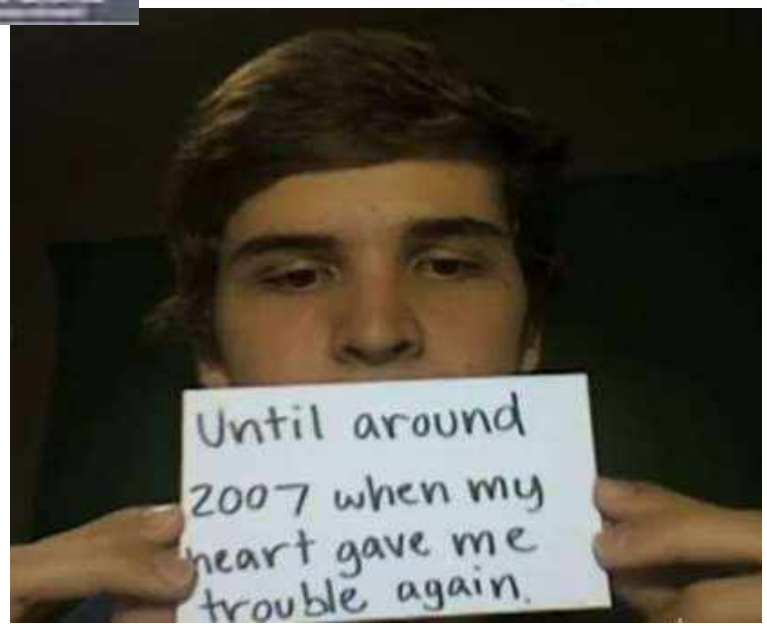
FOUR members of the same family are living time bombs – they have a genetic 'sudden death' condition that could kill them at any moment.

Girl, 17, killed by the sudden noise of her mobile phone



THE DAY MY HEART STOPPED

Girl died minutes after first kiss with boyfriend



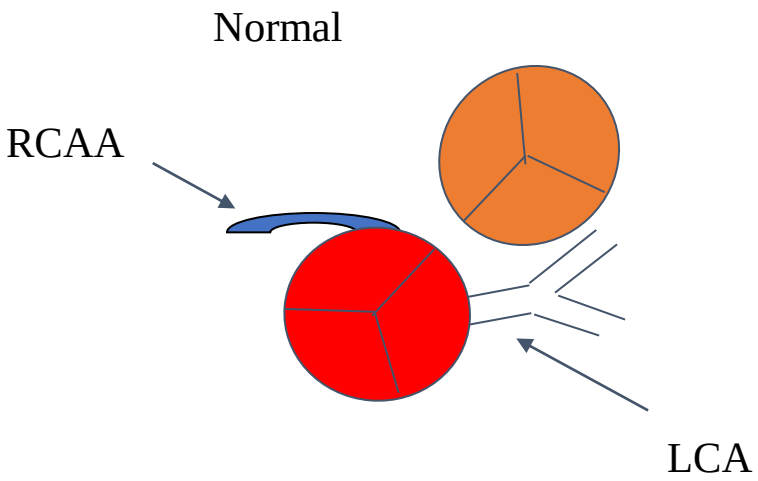
What we will cover

- List common cardiac causes of chest pain in children
- Appreciate when to refer a child presenting with chest pain to cardiology
- Appreciate the importance of QI

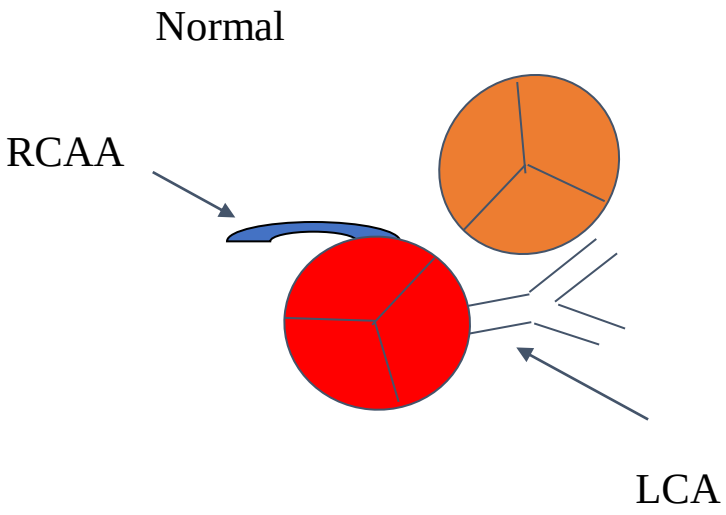
Case presentation

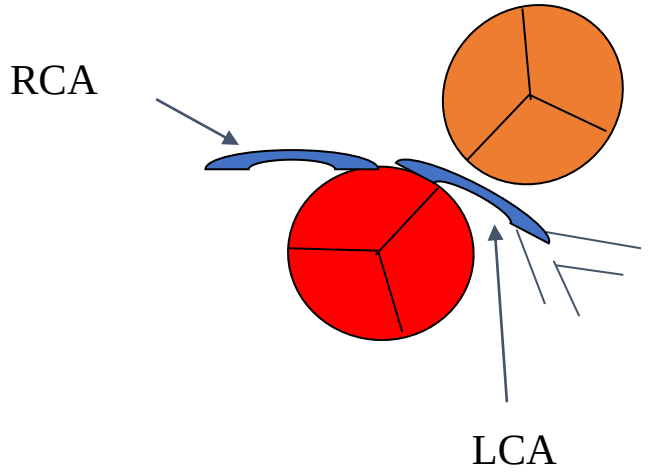
- 15 year old complained of chest pain during activity
- Mother: depression, MGF: heart attack at 52 years
- Normal examination

Coronary artery anomalies



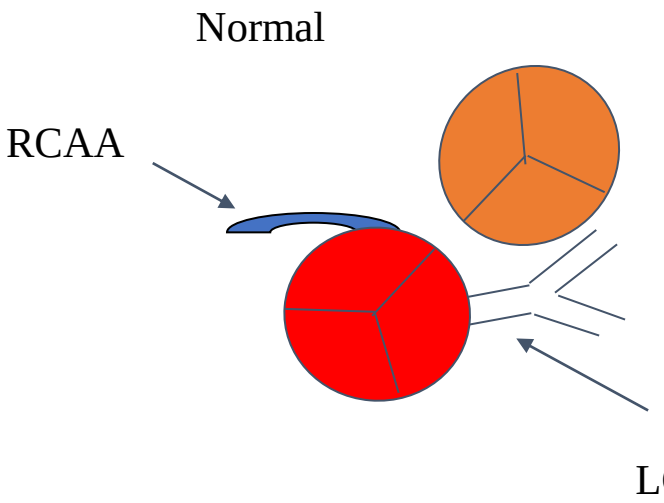
Coronary artery anomalies

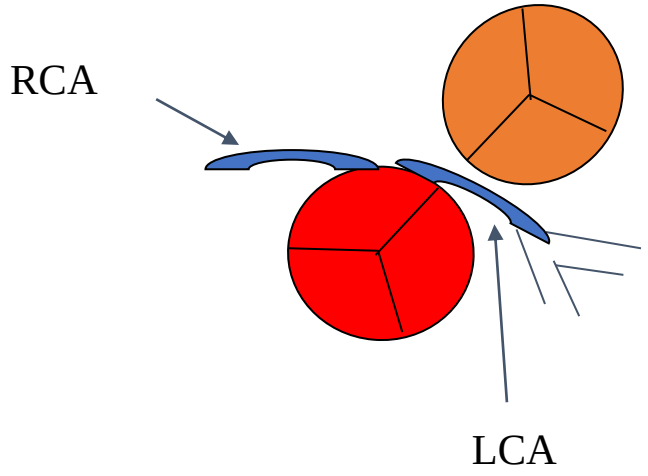




Anomalous origin of LCA from the right sinus

Coronary artery anomalies





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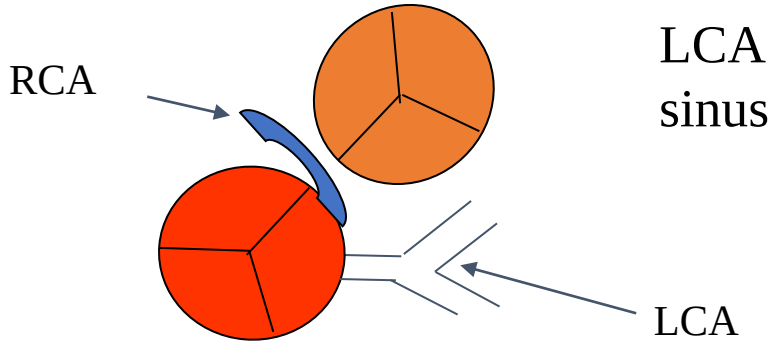
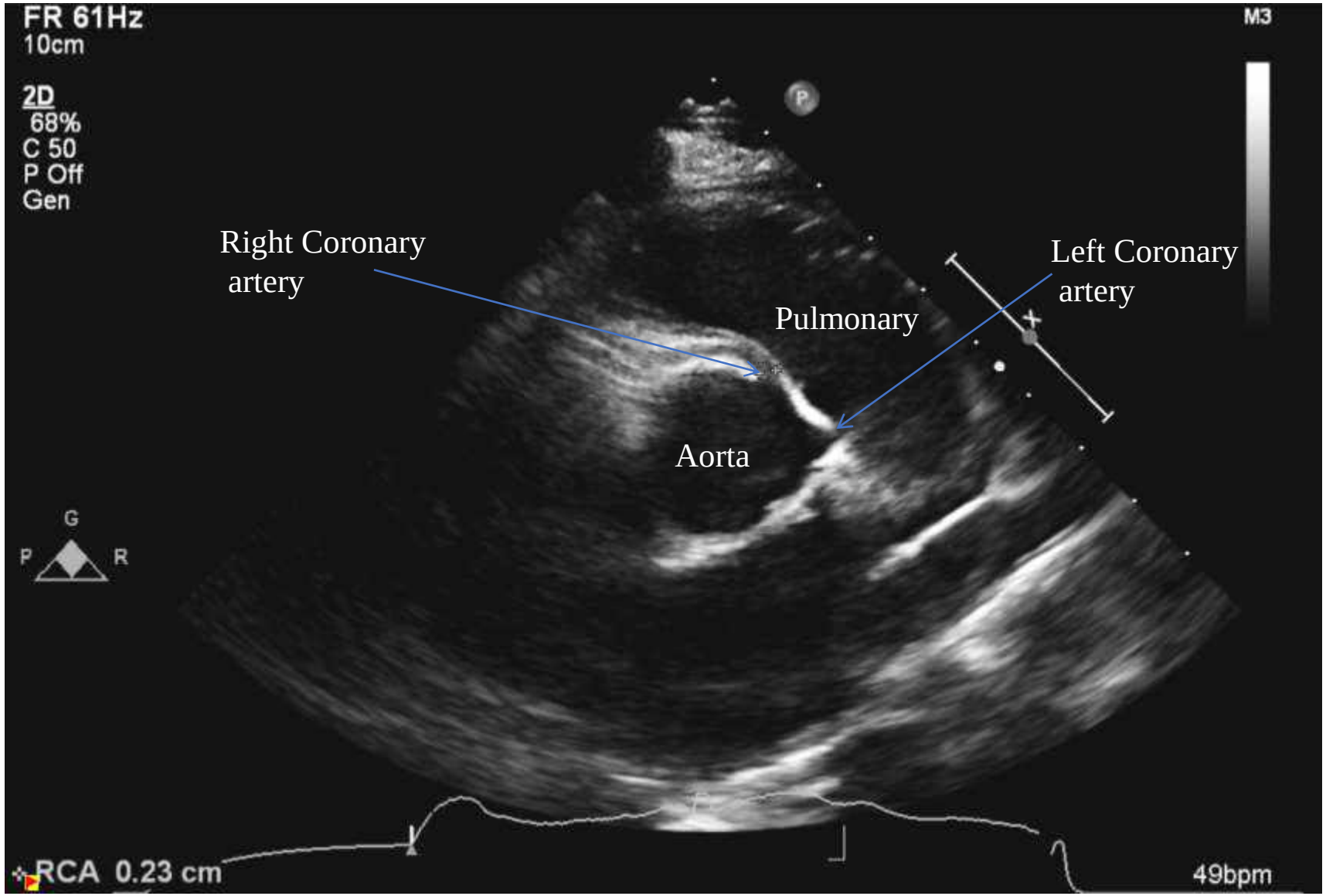


Anomalous origin of RCA from the left sinus


FR 61Hz
10cm
2D
68%
C 50
P Off
Gen
M3
Right Coronary artery
Left Coronary artery
Pulmonary
Aorta
G
P
R
RCA 0.23 cm
49bpm

Case presentation

- 15 year old complained of chest pain during activity
- Mother: depression, MGF: heart attack at 52 years
- Normal examination

Cardiac causes of chest pain

Cardiac causes of chest pain

- Hypertrophic cardiomyopathy
- Coronary artery anomalies
- Aortic stenosis
- Pulmonary hypertension
- Pericarditis/Myocarditis
- Rhythm abnormalities

Chest Pain: When to Refer

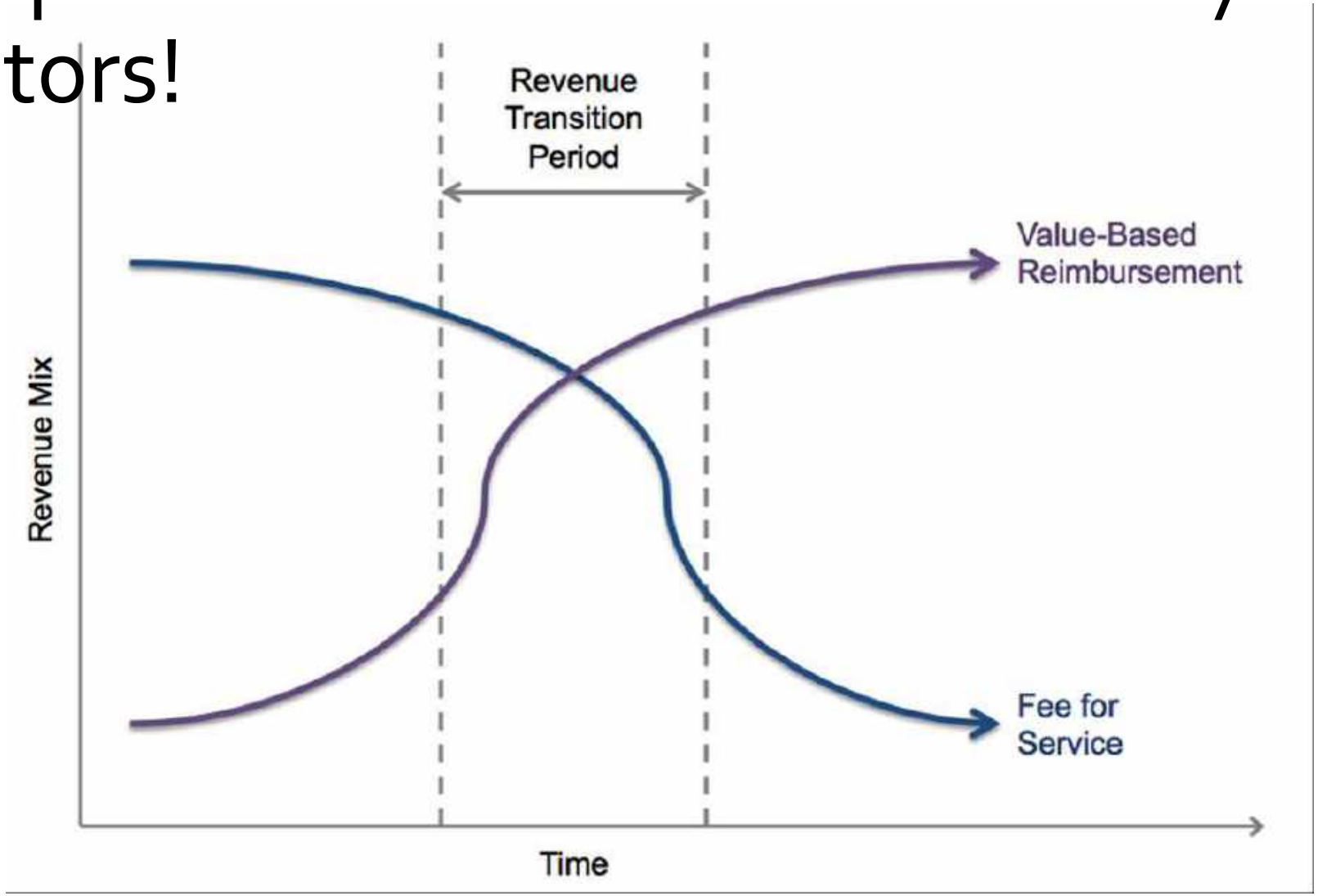
Items Representing Red-Flag for Referrals:

- Patient History
  - Chest pain with exertion
  - Exertional syncope
  - Chest pain that radiates to back, jaw, left arm, or left shoulder
  - Chest pain that increases with supine position
  - Chest pain temporally associated with fever (>38.40C)
- Past Medical History*
  - Hypercoagulable state
  - Arthritis/Vasculitis
  - Immobilization

- Family History
  - Sudden unexplained death
  - Cardiomyopathy
  - Hypercoagulable state
- Physical Examination
  - RR> 40
  - Temperature > 38.4° C
  - Ill-appearing
  - Painful/swollen extremities
  - Non-innocent murmur
  - Distant heart sounds
  - Gallop
  - Pulmonic component of S2
  - Pericardial friction rub
  - Peripheral edema

Harahsheh et al. Clinical Pediatrics (Phila). 2017 Nov;56(13):1201-1208

Your practice will be different than your mentors!



- Courtesy of Mark Weissman

Needs Assessment

- Primary care providers have identified gaps in their education surrounding subspecialty referral
- recognizing red flags for referral

Hamburger et al. Academic pediatrics 2015;15:5-8

Pediatric Chest Pain—Low-Probability Referral: A Multi-Institutional Analysis From Standardized Clinical Assessment and Management Plans (SCAMPs®), the Pe… Da… Me…

Ash…
Bill…

Clinical Pediatrics
2017, Vol. 56(13) 1201–1208

DOI: 10.1177/0009922816684605
journals.sagepub.com/home/cpj
SAGE

Cardiac Disease Explaining Chest Pain 8/3167 (0.25%)

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Group 1 1656/3167 (52.3%)	Group 2 1511/3167 (47.7%)
Patients that met Red Flag Criteria	Patients that did not meet Red Flag Criteria
Cardiac cause for chest pain	8/1,656 (0.48%)
	0/1511 (0%)

Harahsheh et al. Clinical Pediatrics (Phila). 2017 Nov;56(13):1201-1208

The presence of any red-flag identified subjects with a cardiac cause of chest pain with:

- 100% sensitivity (zero false negatives)
- 48% specificity
- 0.5% positive predictive value
- 100% negative predictive value

** Highly Sensitive Tests are Ideal for Screening **

Quality Improvement

Pediatric Health Network

Children's National

Aim

- …To decrease low probability cardiology referrals from Children's Pediatricians & Associates primary care pediatricians in pediatric patients ages 7-21 who present with chest pain from 17% to 5% by 01/01/2020

Pediatric Health Network
Children's National

Revision Date: ***01/01/2019***

SMART Aim

Decrease low probability *cardiology referrals from Children's Pediatricians & Associates primary care pediatricians in pediatric patients ages 7-21 who present with chest pain from 16% to 5% by 01/01/2020

Global Aim

Reducing low probability referrals to cardiology from primary care pediatricians in Pediatrics

Key Drivers

- Applying Evidence based medicine in triaging
- Pediatrician education
- Improving Provider compliance
- Patients and Families' education

Key

= *completed intervention*

= *what we're working on right now*

Interventions

- Utilize a validated screening tool in triaging chest pain in children (Clinical Pediatrics (Phila). 2017 Nov;56(13):1201-1208)
- Develop a EMR smart phrases, standard documentation templates (decision support tool 02/2018))
- Conduct an in person Pilot group Pediatrician education (01/2018)
- Conduct an in person large group Pediatrician education
- Develop an online Pediatrician education
- Implement site specific reminders to increase compliance (email communication with those varying from guideline, Faculty meeting discussions, webinars,…)
- Apply for ABP MOC part 4
- Develop educational program/material for children and parents related to appropriate evaluation of children with chest pain

Process measure

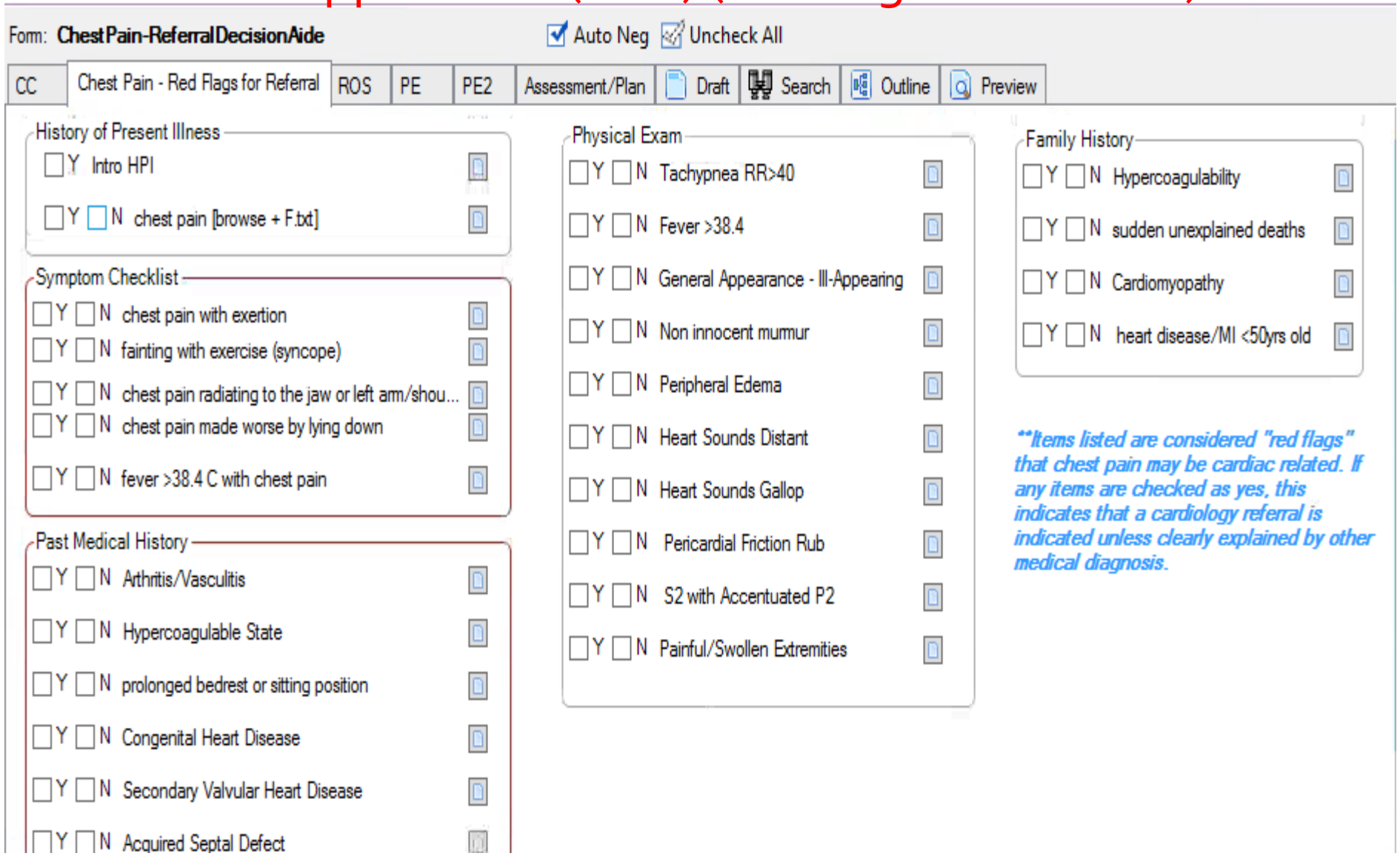
Improve primary pediatrician's Utilization of Decision Support Tool (DST) (red-flags for referral)

Outcome Goal: Decrease low probability referrals to cardiology for chest pain

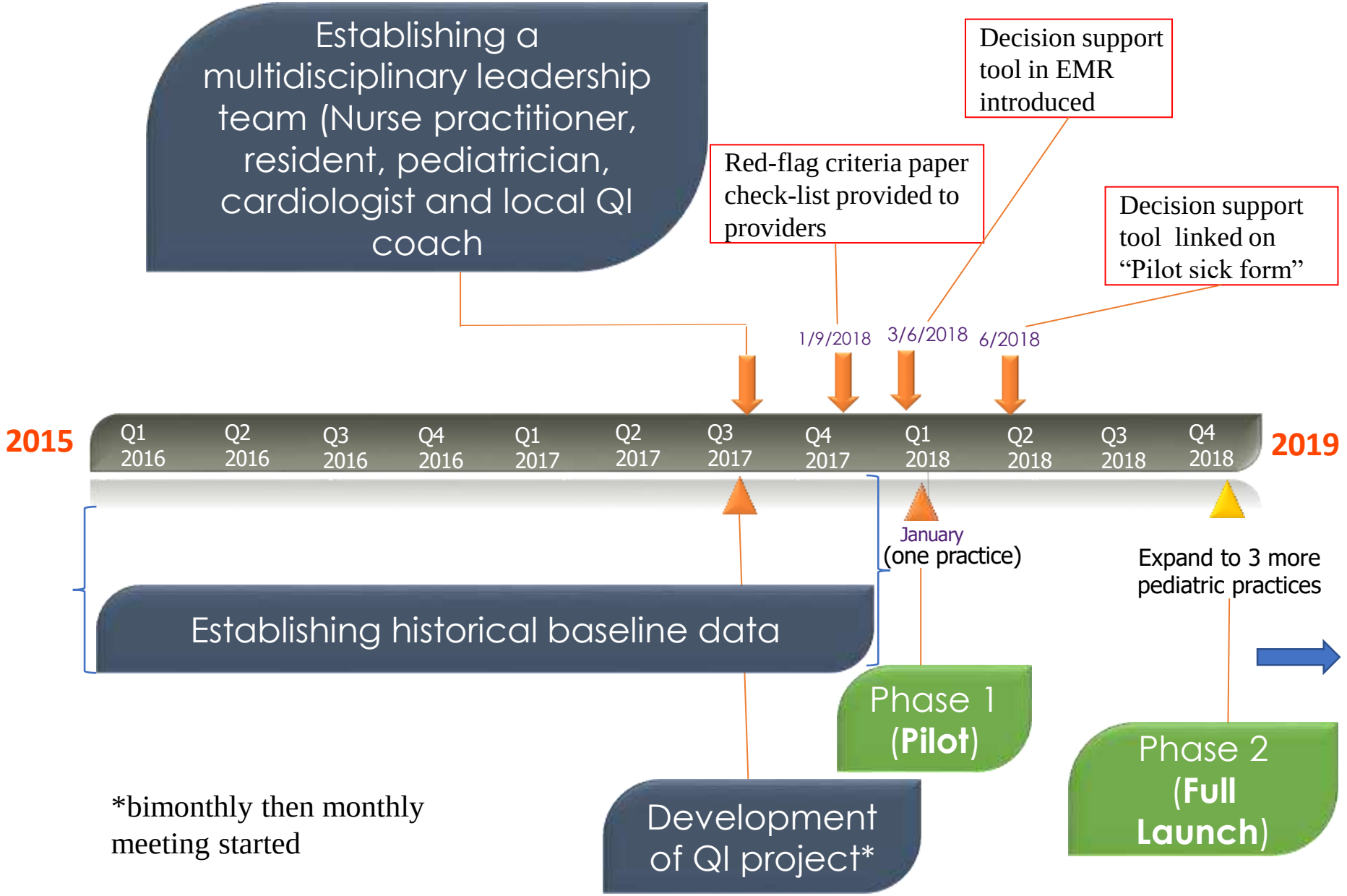
Balancing measure- Patient safety- missing life threatening event and/or incidental cardiac finding

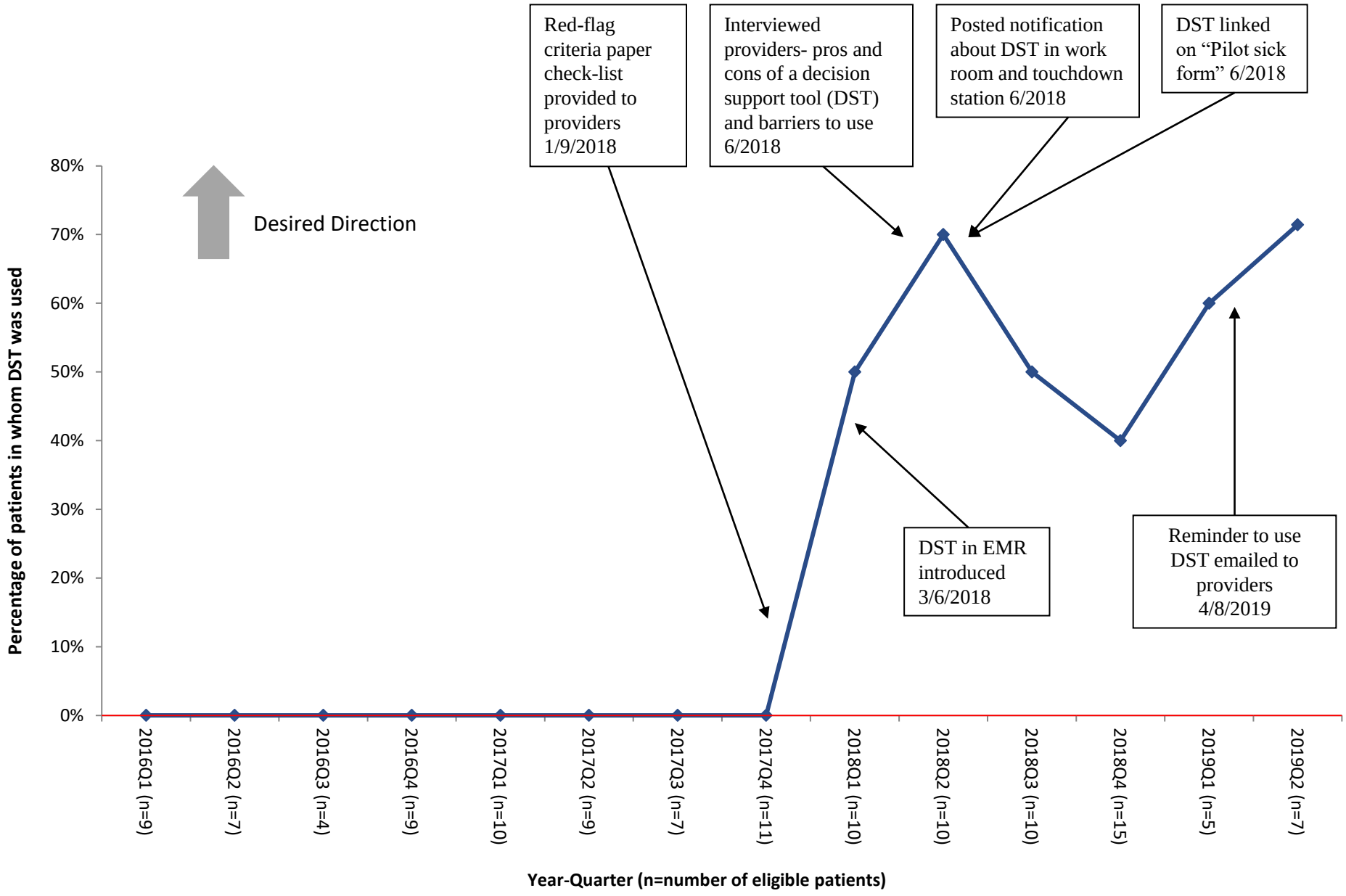
Harahsheh et al. Promoting Judicious Primary Care Referral of Patients with Chest Pain to Cardiology: A Quality Improvement Initiative. Medical Decision Making. Accepted for publication. 2021

Decision Support Tool (DST) (red-flags for referral)



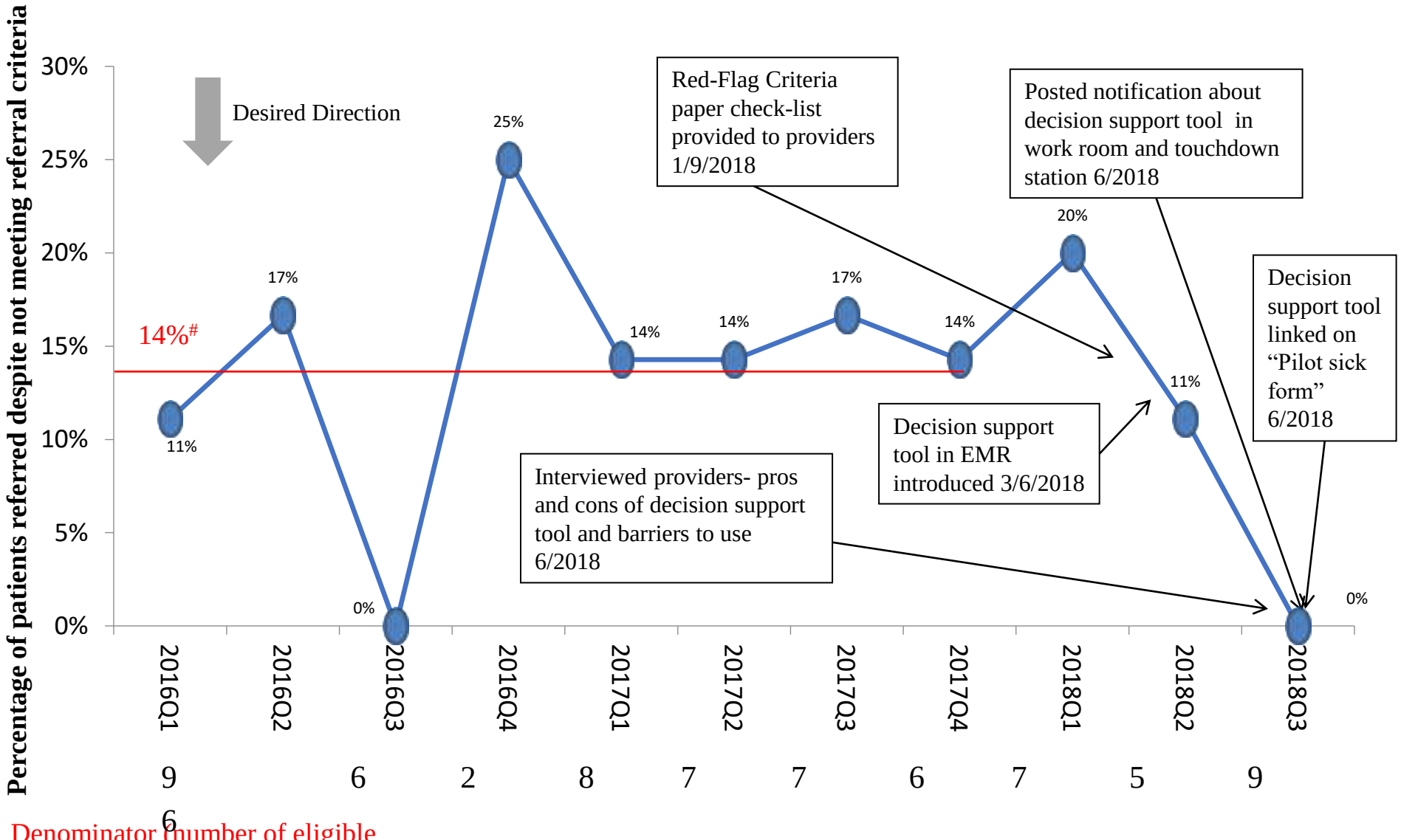
Phase I
Pilot data


Establishing a multidisciplinary leadership team (Nurse practitioner, resident, pediatrician, cardiologist and local QI coach
Red-flag criteria paper check-list provided to providers
Decision support tool in EMR introduced
Decision support tool linked on "Pilot sick form"
1/9/2018
3/6/2018
6/2018
2015
Q1 2016
Q2 2016
Q3 2016
Q4 2016
Q1 2017
Q2 2017
Q3 2017
Q4 2017
Q1 2018
Q2 2018
Q3 2018
Q4 2018
2019
January
(one practice)
Expand to 3 more pediatric practices
Establishing historical baseline data
Phase 1 (Pilot)
Phase 2 (Full Launch)
Development of QI project*
*bimonthly then monthly meeting started



Process measure: Improve Utilization of Decision Support Tool (DST) (red-flags for referral)

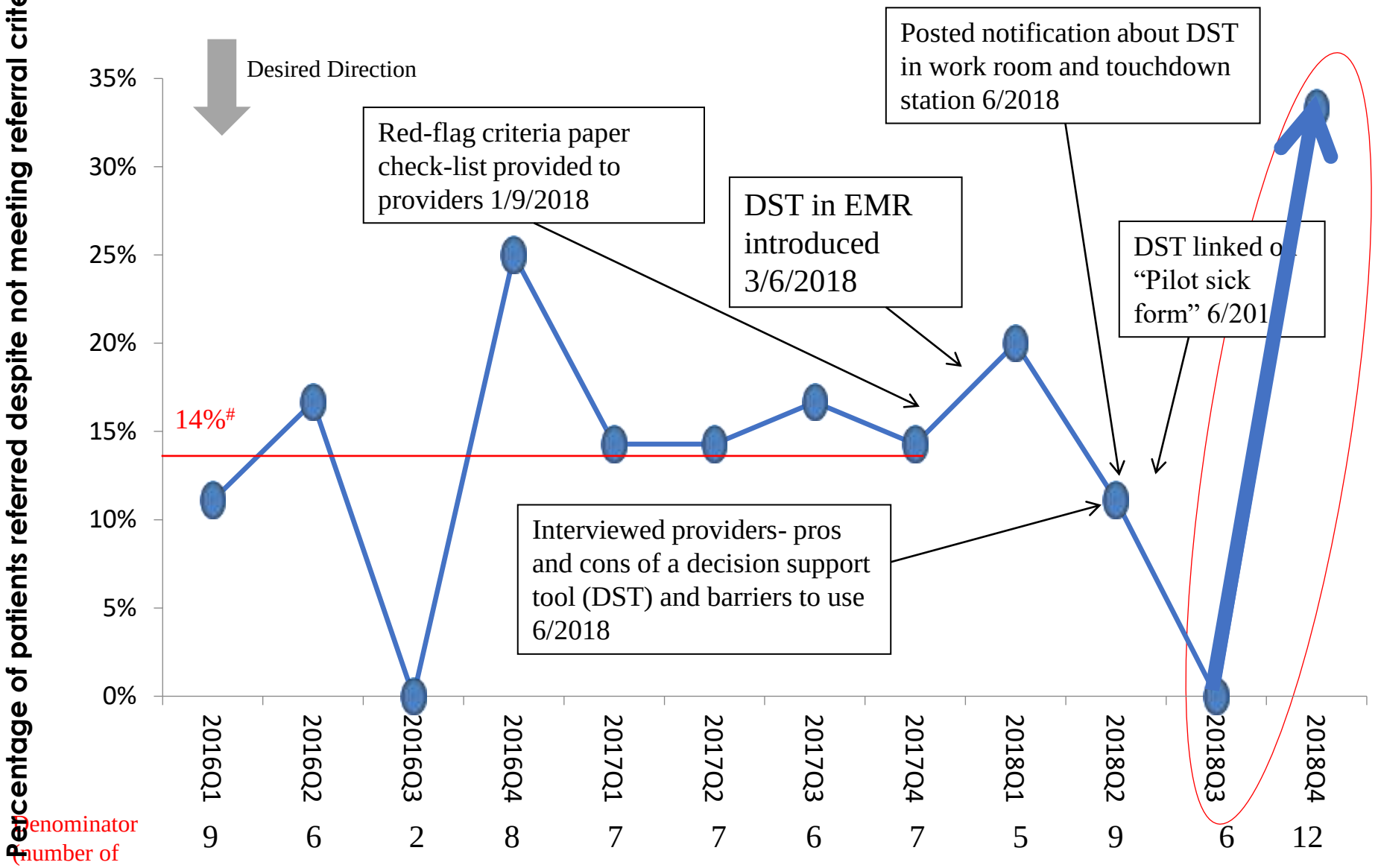
Goal: Decrease low probability referrals for cardiac disease explaining chest pain



Denominator (number of eligible patients)

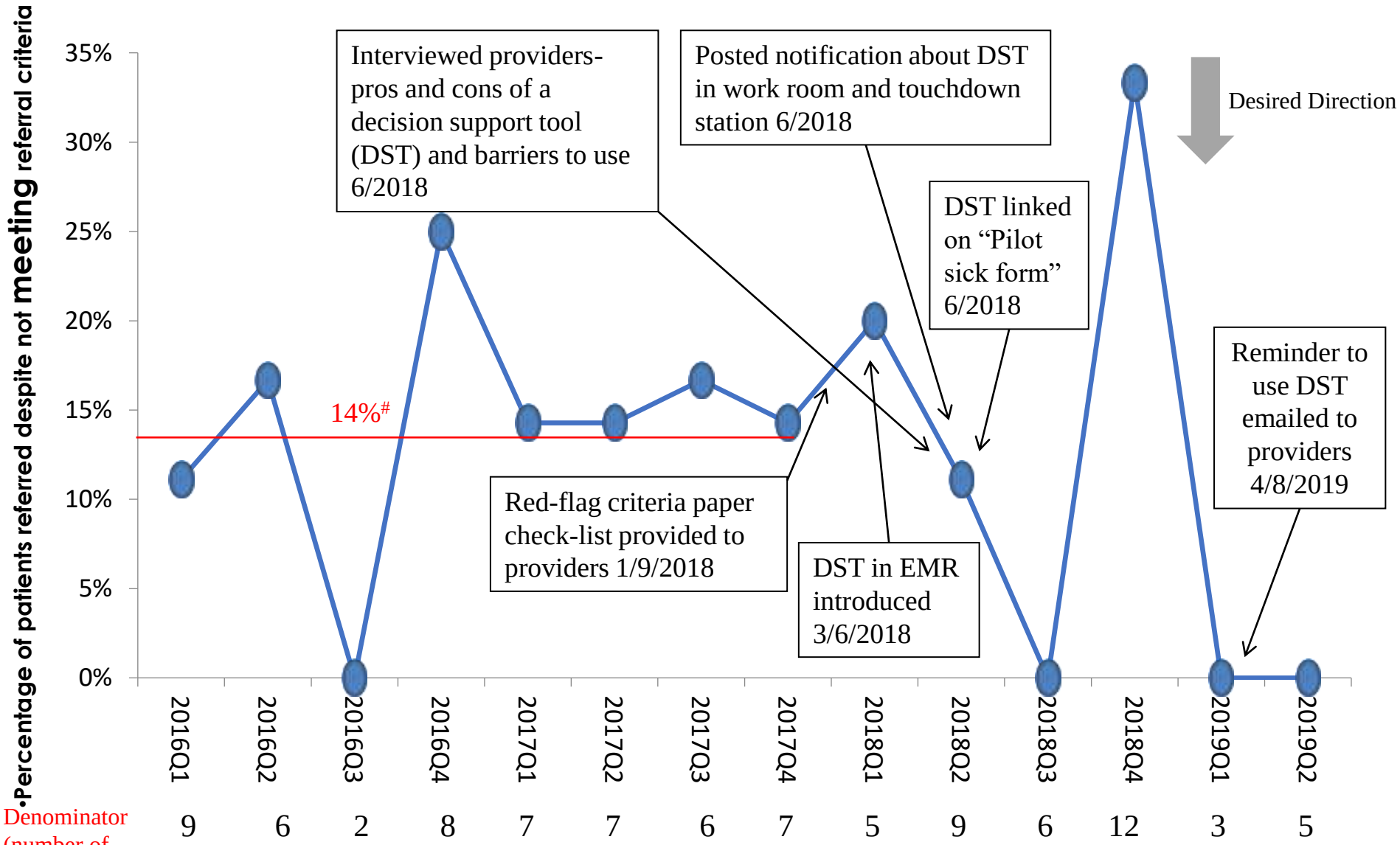
Median

Goal: Decrease low probability referrals for cardiac disease explaining chest pain



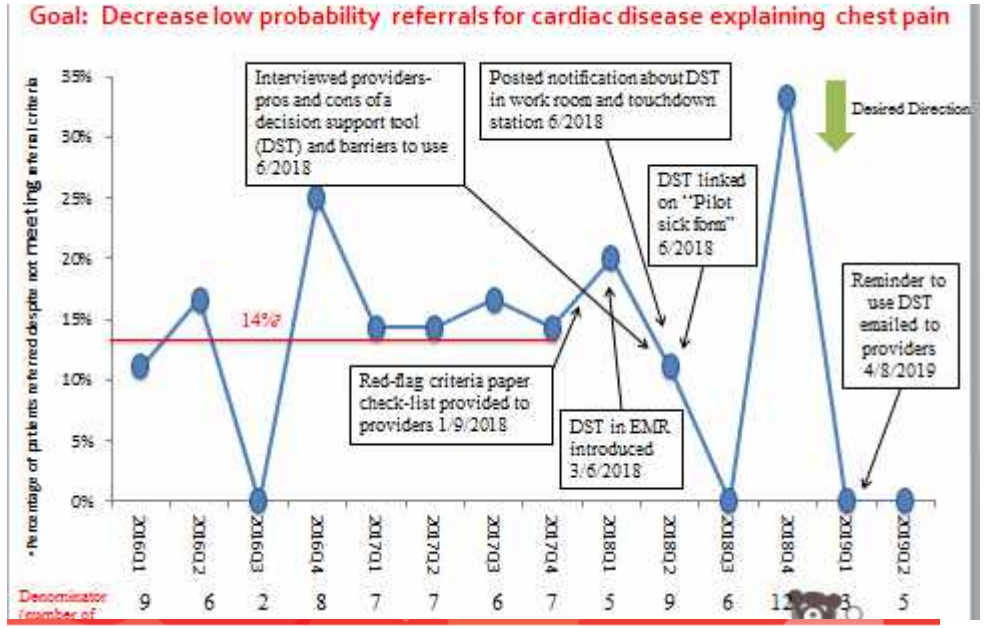
Median

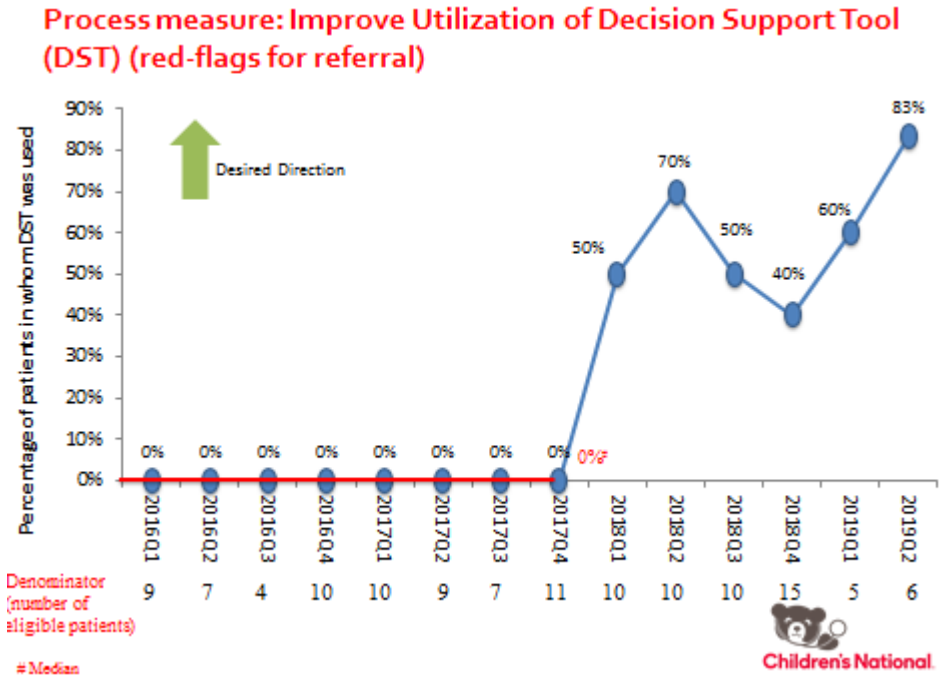
Goal: Decrease low probability referrals for cardiac disease explaining chest pain



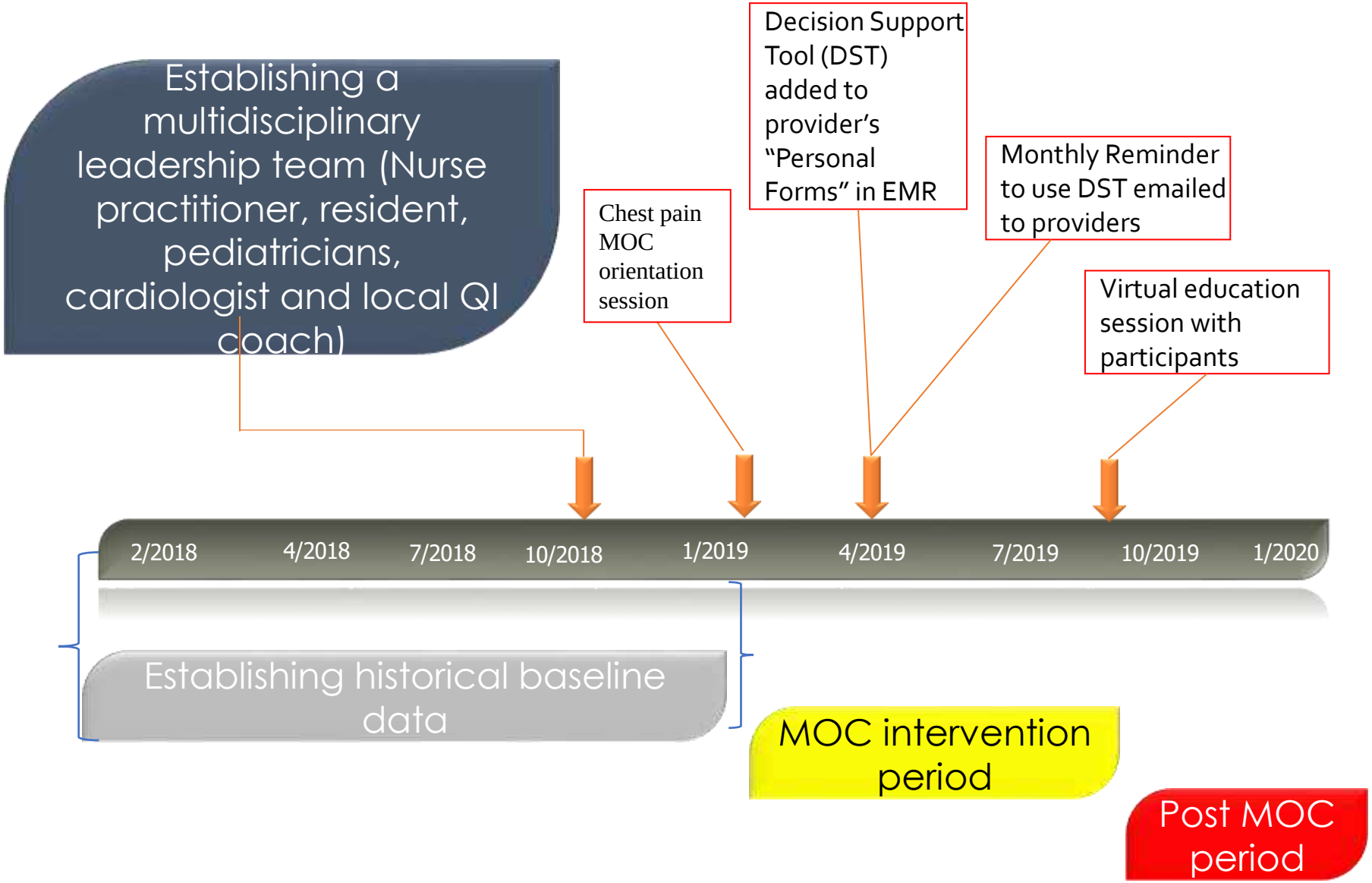
Median

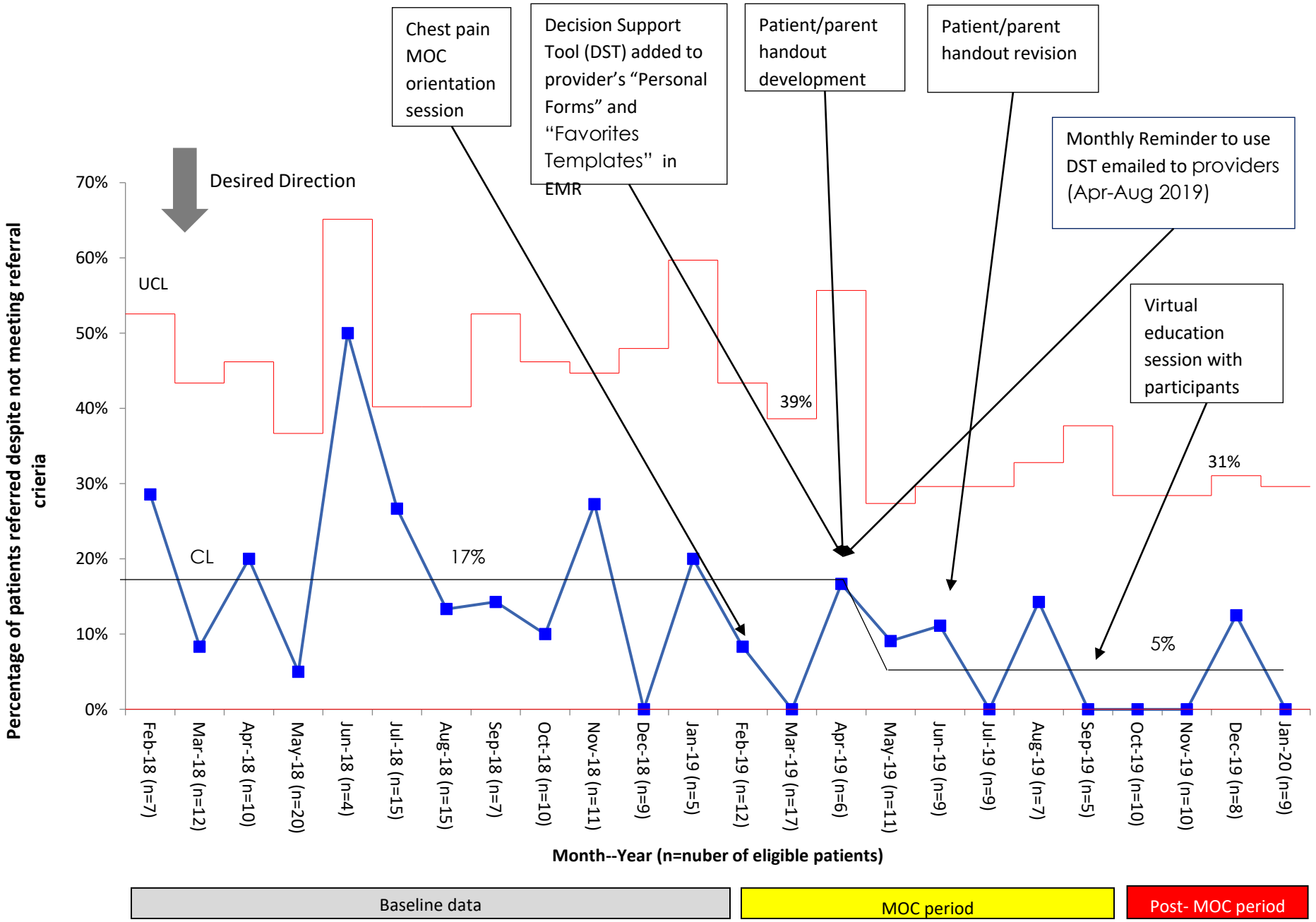
Harahsheh et al. 2019 AAP National meeting poster



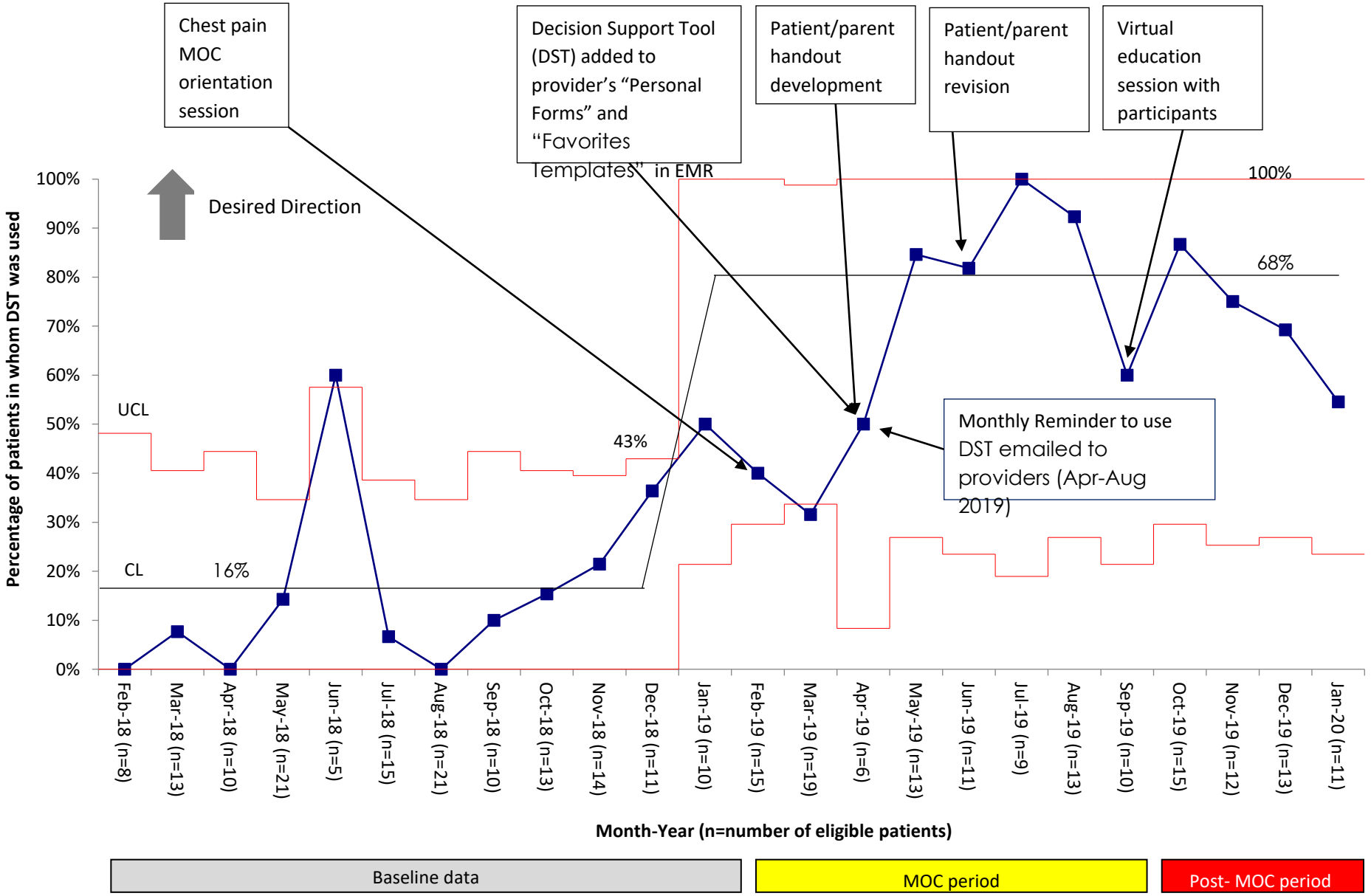


Phase II


Establishing a multidisciplinary leadership team (Nurse practitioner, resident, pediatricians, cardiologist and local QI coach)
Chest pain MOC orientation session
Decision Support Tool (DST) added to provider's "Personal Forms" in EMR
Monthly Reminder to use DST emailed to providers
Virtual education session with participants
2/2018
4/2018
7/2018
10/2018
1/2019
4/2019
7/2019
10/2019
1/2020
Establishing historical baseline data
MOC intervention period
Post MOC period



Outcome Goal: Decrease low probability referrals for cardiac disease explaining chest pain



Process measure: Improve Utilization of Decision Support Tool (DST) red-flags for referral)

Balancing measure- Patient safety- missing life threatening event and/or incidental cardiac finding

referral

Median follow up time of 0.94
(Interquartile range 0.3-1.6) years
Mean follow up 1.1±0.9 years

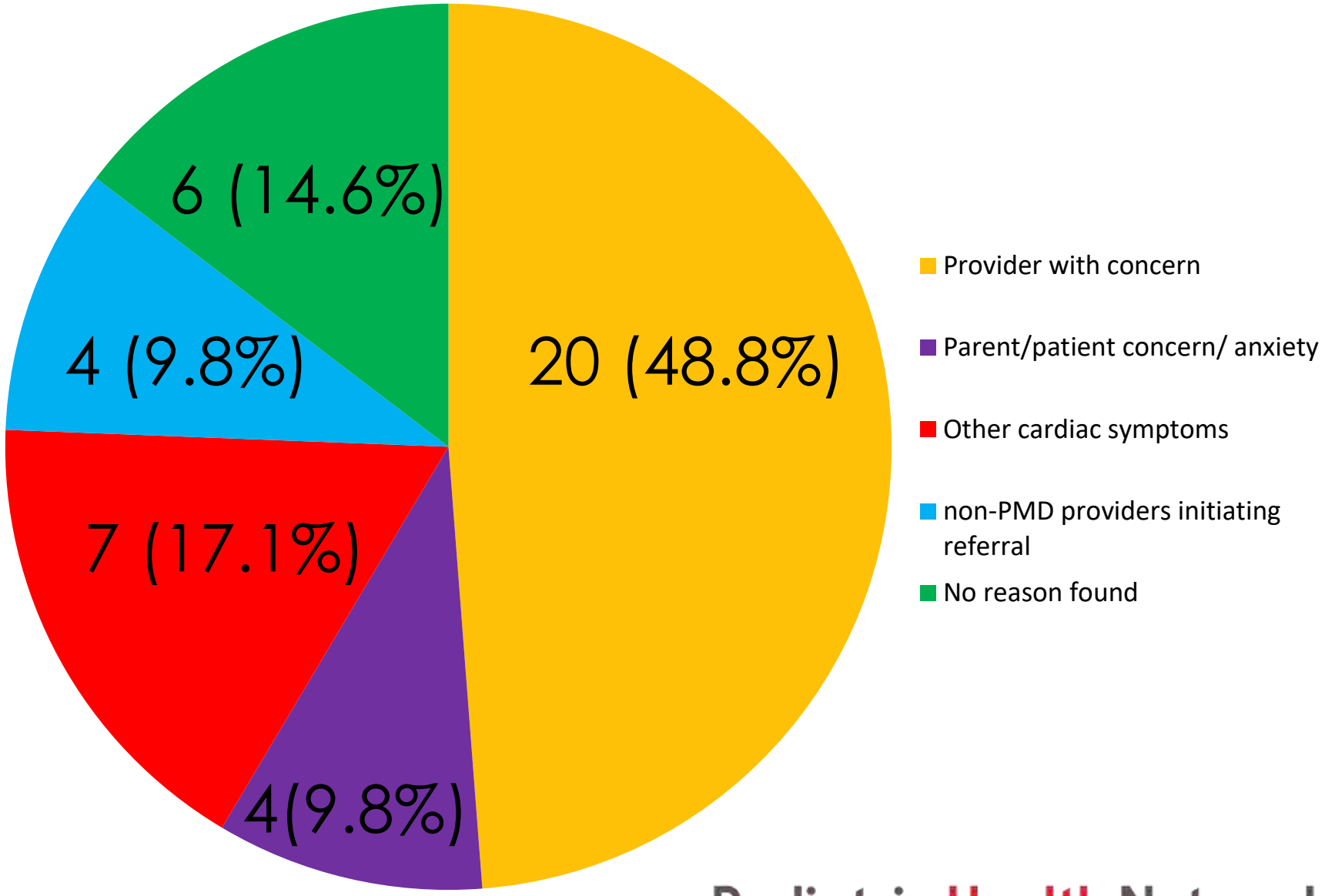
- **First patient:**
  - Bicommissural aortic valve, right/left fusion with trivial aortic valve insufficiency

- **Second patient** (31 months after first PMD visit)
  - **Holter occasional premature ventricular beats** of **2 distinct morphologies**, but no ventricular tachycardia. **probable Mobitz type II block**
- **Normal stress test with no ectopy or blocks**

- **Third patient**
  - asymptomatic WPW

Why low probability referral occur?

Reason for low probability referral in children presenting with chest pain



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Reason for low probability referral in children presenting with chest pain

Item	Number of comments (%)	Representative comments
Other cardiac symptoms	7 (17.1%)	Possible causes could be reflux, asthma, anxiety. Given stature, >95th percentile and
		disease], but does report palpitations and had syncope (though this was non-exertional, in the context of gastroenteritis with dehydration) so referred to cardiology to r/o cardiac cause
		Abnormal irregular heart rate for ECG
Provider with concern	20 (48.8%)	Given localization of pain to left chest, quality of pain and no clear etiology, will refer to cardiology for further work up
		for ECG to r/o abnormality not noted on exam
		Costochondritis (Tietze's syndrome) referral given for cardiology given increase in symptoms, history and physical exam reassuring for [costochondritis]
non-PMD providers initiating referral	4 (9.8%)	Incidental finding of LVH on EKG preformed during hospitalization for seizures. Provider noted that this chest pain incident likely precordial catch and not cardiac in etiology.
		This appointment was ED follow-up. Although provider noted that 'low suspicion for cardiac etiology of chest pain' patient had already been referred from ED due to possible LVH on EKG.
Parent/patient concern and/or anxiety	4 (9.8%)	Anxiety about her chest pain, would like to see Cardiology
		Patient concerns
No reason was identified	6 (14.6%)	

This appointment was ED follow-up. Although provider noted that 'low suspicion for cardiac etiology of chest pain' patient had already been referred from ED due to possible LVH on EKG

Case 2

- 15 y.o. Jane presents with chest pain. The pain was not exercise induced, nor was it associated with other cardiac symptoms.
- It was aggravated by breathing.
- She has a normal examination including reproducible pain on palpation, benign family and past histories.
- You explain that she does not need a referral to cardiology, but her mother is quite **insistent** that she would like the referral to be sure there is nothing wrong with her heart

Items Representing Red-Flag for Referrals:

- Patient History
  - Chest pain with exertion
  - Exertional syncope
  - Chest pain that radiates to back, jaw, left arm, or left shoulder
  - Chest pain that increases with supine position
  - Chest pain temporally associated with fever (>38.40C)
- Past Medical History*
  - Hypercoagulable state
  - Arthritis/Vasculitis
  - Immobilization

- Family History
  - Sudden unexplained death
  - Cardiomyopathy
  - Hypercoagulable state
- Physical Examination
  - RR> 40
  - Temperature > 38.4° C
  - Ill-appearing
  - Painful/swollen extremities
  - Non-innocent murmur
  - Distant heart sounds
  - Gallop
  - Pulmonic component of S2
  - Pericardial friction rub
  - Peripheral edema

Harahsheh et al. Clinical Pediatrics (Phila). 2017 Nov;56(13):1201-1208

Conclusion

- This quality improvement initiative to reduce low probability cardiology referrals for children presenting to primary care practices with chest pain was **feasible, effective and safe**

Thank you

Leadership
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Anusha Rao, MHSA
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Children's National

May 2024

Question 1

An 8 year old girl has had retrosternal chest pain for 1 week. Her general physical examination is normal. Of the following, which feature is most likely to suggest a cardiac pathologic state needing further evaluation?

A. Sharp, stabbing in nature

B. Occurs only at rest

C. Occurs only with inspiration

D. Occurs only with exercise

E. Associated with point tenderness

Answer 1

- **Correct Response:** D
- Red flag for referral in children with chest pain include any of the following:
  - Chest pain with exertion
  - Chest pain that radiates to back, jaw, left arm, or left shoulder
  - Chest pain that increases with supine position
  - Chest pain temporally associated with fever (>38.40C)

Question 2

- You are evaluating a 15 year old boy who presented with chest pain. The pain was not radiating and not associated with sports. The family history was reassuring and examination was normal apart from reproducible pain at left sternal border. After explaining the benign nature of chest pain, the mother became angry mandating referral to cardiology. The best next step is:

Question 2

A. Refer to Cardiology
B. Refer to emergency department
C. Ask the family to see another pediatrician
D. Obtain an ECG
E. Determine the concerning element

Answer 2

- **Correct Response:** E
- It is absolutely important to determine the underlying agenda/ concern that families sometimes bring with common complaint. A patient with benign entity can and should be handled within the pediatrician's office (medical home). Referring to cardiology and/or obtaining testing is not appropriate as the patient has no red-flag for referral.

Question 3

- You are evaluating a 16 year old boy with chest pain. The chest pain occurred while the child was sitting. You decided not to refer the patient to cardiology. A medical student asked about cardiology referral criteria for patients presenting with chest pain. In answering the medical student which of the following is true:

Question 3

A. The majority of patients referred to cardiology with chief complaint of chest pain have an underlying heart disease
B. About 30% of children with noncardiac chest pain have associated panic disorder
C. No known red-flag criteria has shown high sensitivity in identifying cardiac disease explaining chest pain
D. All patients presenting with chest pain need to see cardiology
E. All patients presenting with chest pain need to be exercise restricted

Answer 3

- **Correct Response:** B
- Previous report have shown 20-47% of children with noncardiac chest pain have associated panic disorder. Patients presenting with chest pain need to be triaged by their pediatrician and only those with medical red-flag criteria for referral should be referred to cardiology and exercise restricted until cardiology evaluation is completed. 0.25% to 4% of patients presenting with chest pain have cardiac disease explaining their complaint. A medical red-flag criteria has been shown to be sensitive in identifying cardiac disease explaining chest pain

Family of metrics tracked

Goal	Metric	Numerator	Denominator	Frequency of obtaining data	Data source	Planned goal
Outcome Goal: Decrease low probability referrals when evaluating a pediatric patient presenting with chest pain	Low probability referrals	Number of patients with no red-flag for cardiology referral (All elements in HPI, PMH, Family history and examination) but referred to cardiology	Number of patients who presents to the PCP office with chest pain and no red-flag for cardiology referral within the measurement period	Monthly	EMR at CNP&A EMR –CNHS (Cardiology visits)	Decrease by 50% of the bassline level
Process measure: Improve primary pediatrician's utilization of red-flags for referral tool when evaluating a pediatric patient presenting with chest pain	Complete red-flag-referral tool	Number of patients with a complete red-flag item tool (All elements in HPI, PMH, Family history and examination)	Number of patients who presents to the PCP office with chest pain within the measurement period	Monthly	EMR at CNP&A	Increase to 80%
Balancing measure- Patient safety	Missing life threatening event	Number of patients found to have life threatening event despite not having any red-flag for cardiology referral	Number of patients who presents to the PCP office with chest pain and have no red-flag for cardiology referral within the measurement period	Every 6 months	EMR at CNP&A EMR –CNH (Cardiology visits, Emergency department)	
	Incidental finding of cardiac disease (not cause of chest pain)	Number of Referrals Leading to Incidental finding of cardiac disease (not cause of chest pain) despite not having any red-flag for cardiology referral	Number of patients who presents to the PCP office with chest pain and have no red-flag for cardiology referral within the measurement period	Every 6 months	EMR at CNP&A l EMR –CNH (Cardiology visits)	

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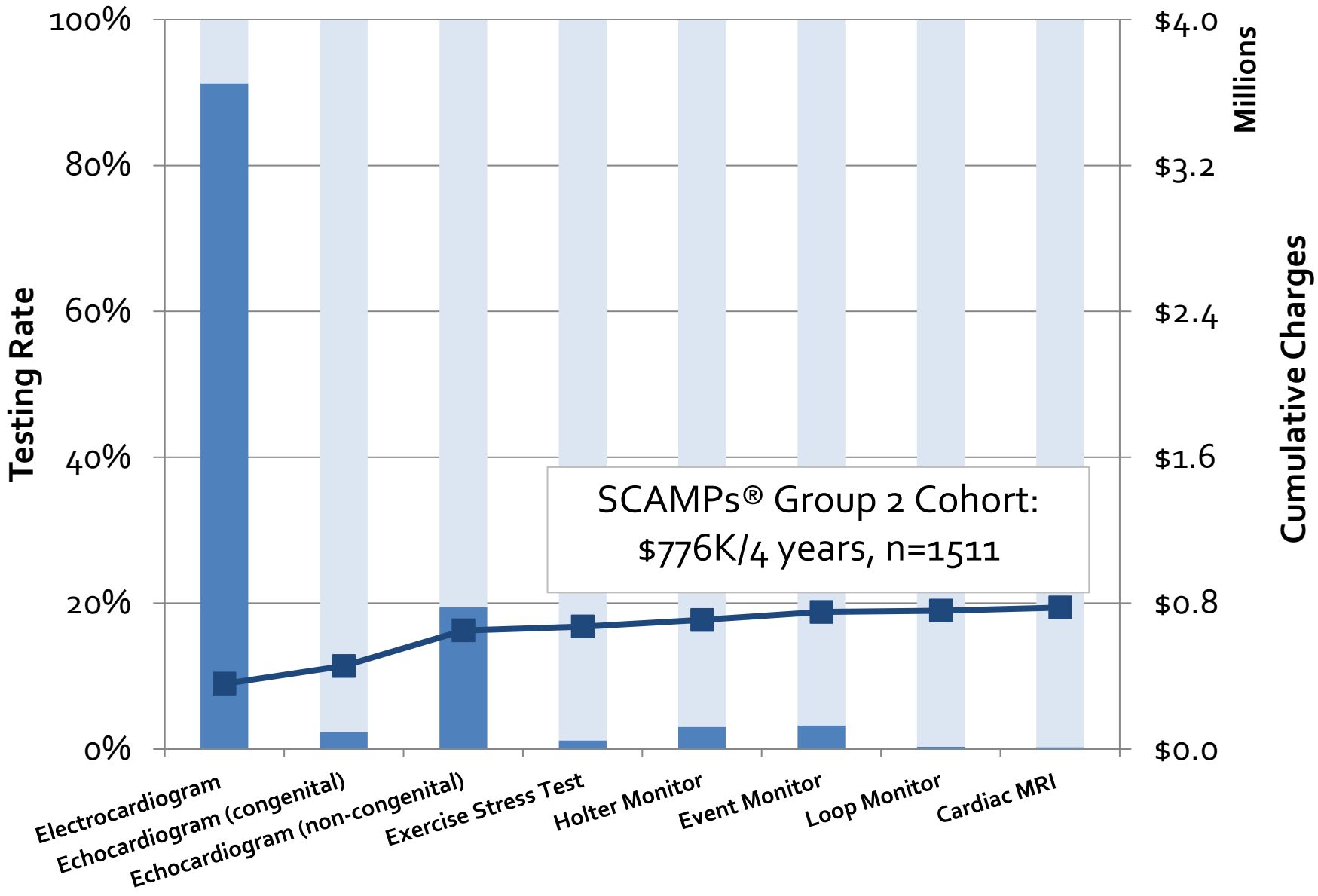
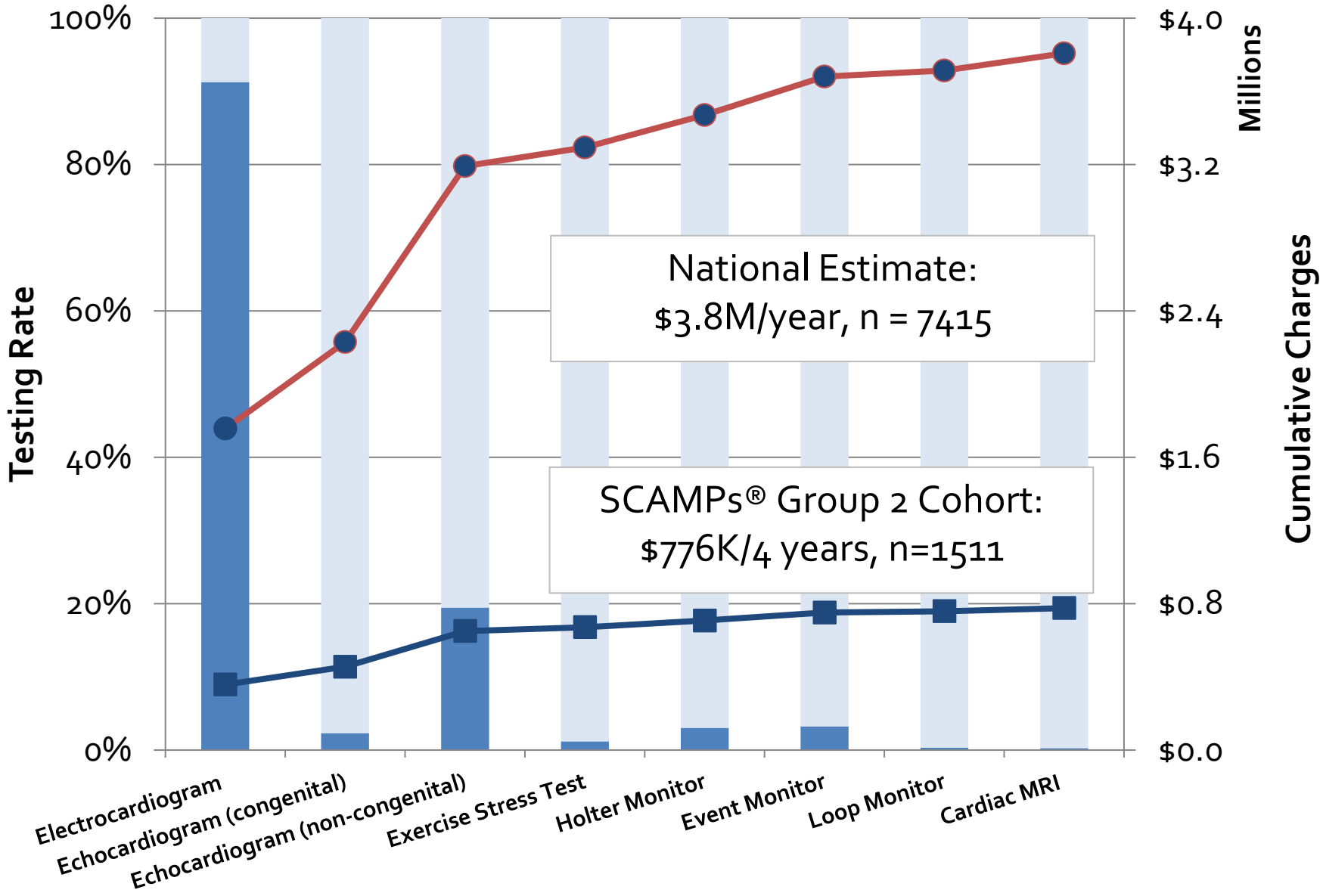
Charges of low probability cardiology referrals

Testing Rate and Total Charges (US2014$)

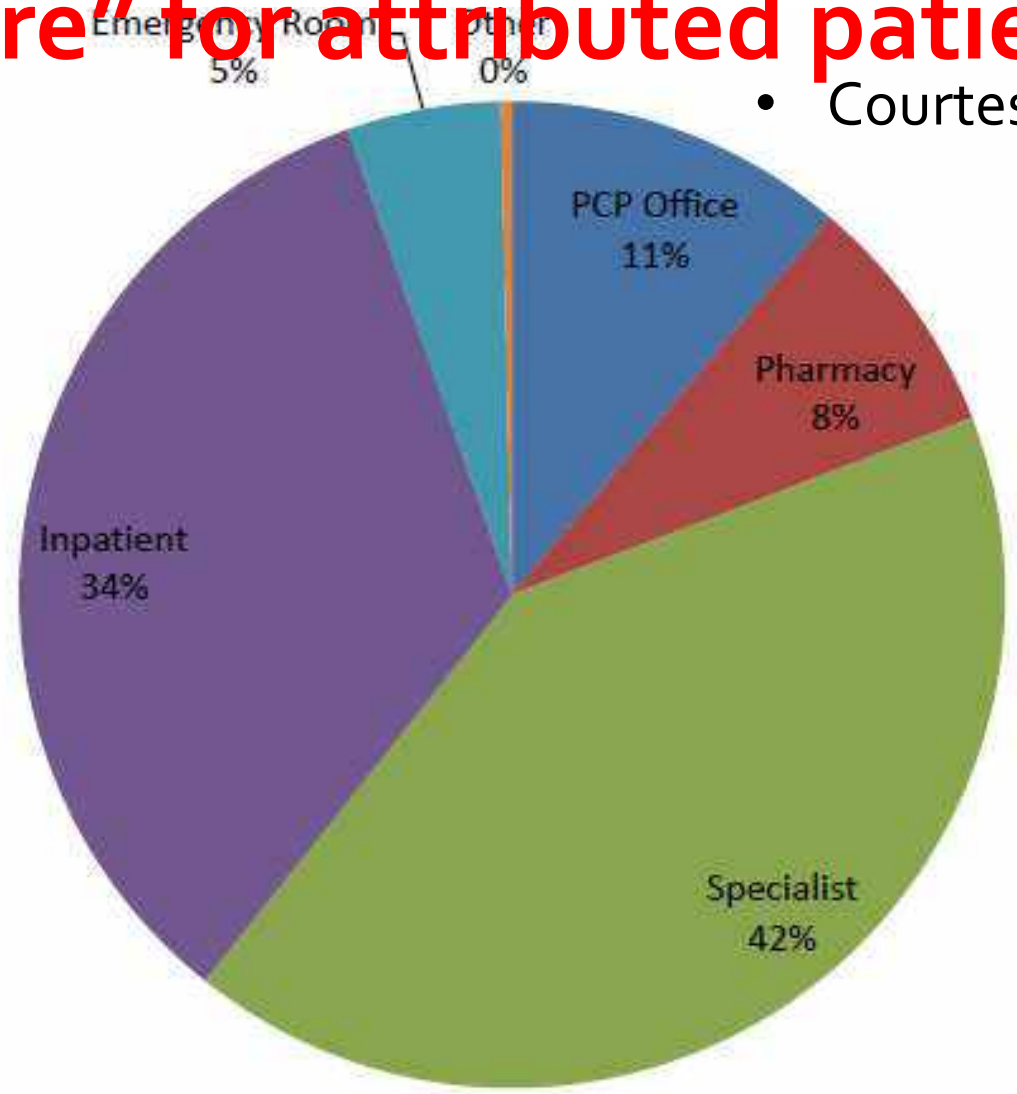


Testing Rate and Total Charges (US2014$)



Pediatricians increasingly "accountable" for "total cost of care" for attributed patients

- Courtesy of Mark Weissman



CareFirst Sample Pediatric PCMH Expense