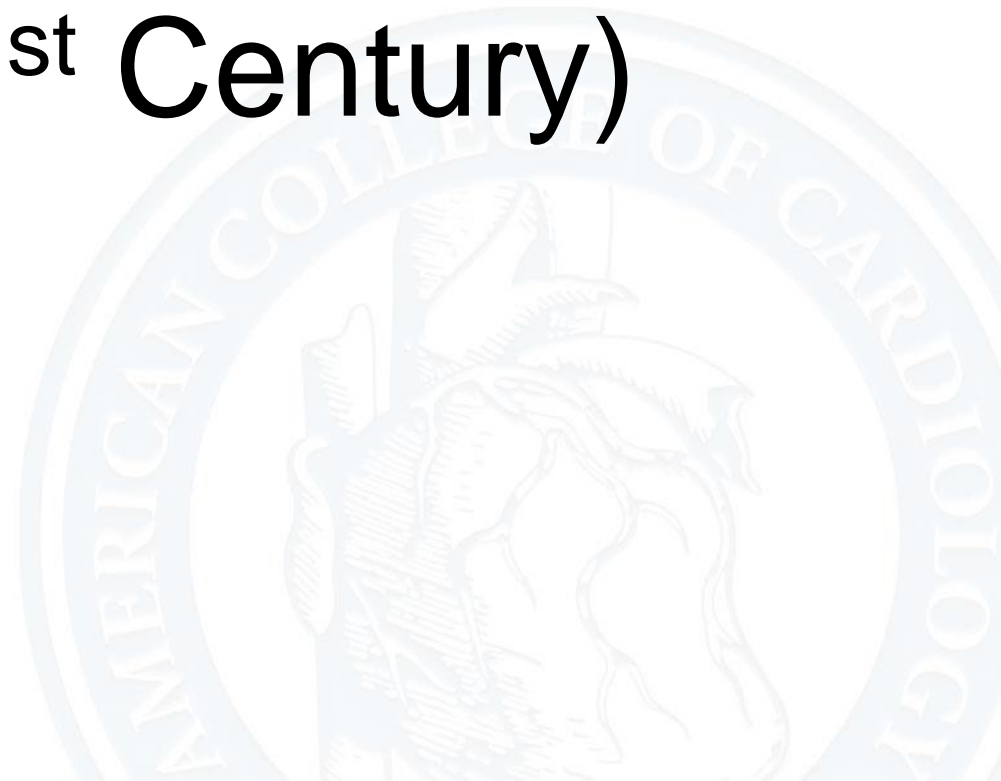


# ACC/AHA Guidelines (In the 21<sup>st</sup> Century)



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**A 32 y/o woman just walked into your office who had a mechanical St Jude MVR 5 years ago. Her INR has been 3.0 on 3 mg warfarin per day. Guess what?**

**She is 8 weeks pregnant**

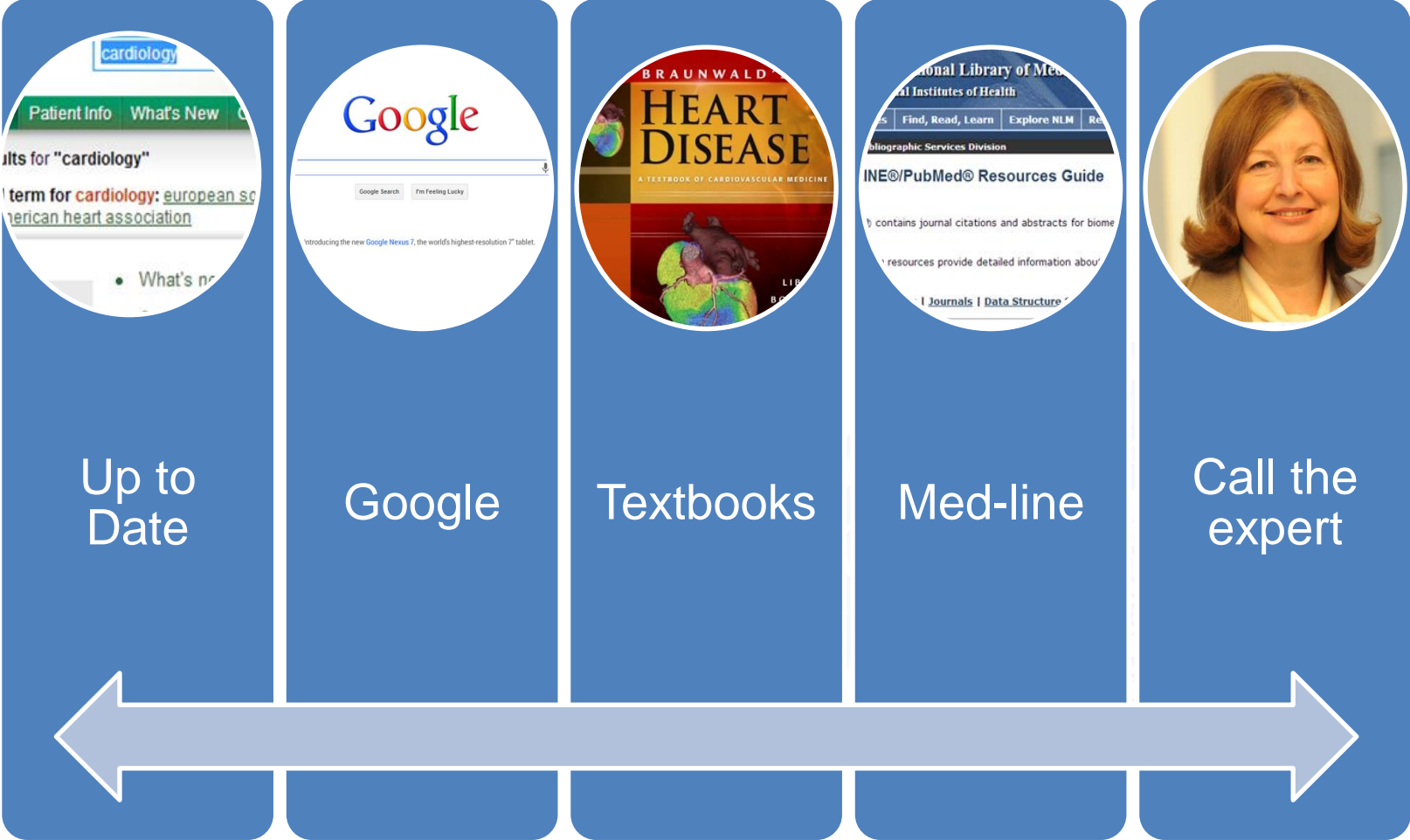


# Do you know what to do?

- 1. Continue warfarin**
- 2. Switch to LMWH**
- 3. Switch to subq UFH**
- 4. I don't know**



# Where do we go for knowledge? - quickly



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# ACC/AHA Practice Guidelines

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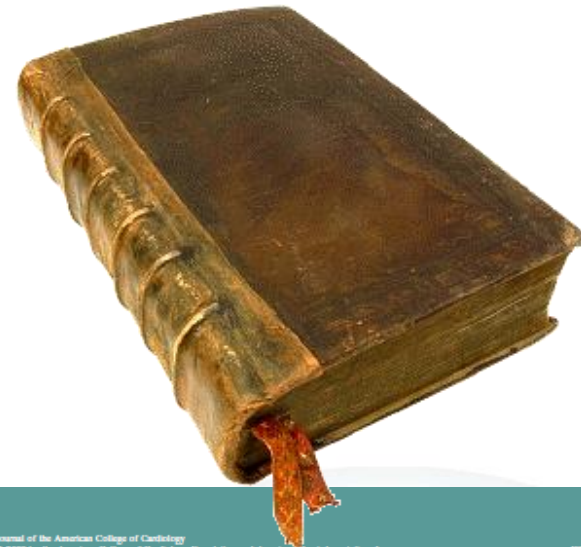
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# ACC/AHA Practice Guideline



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## PRACTICE GUIDELINE: FULL TEXT

### ACC/AHA 2008 Guidelines for the Management of Adults With Congenital Heart Disease

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Develop Guidelines on the Management of Adults With Congenital Heart Disease)

*Developed in Collaboration With the American Society of Echocardiography, Heart Rhythm Society, International Society for Adult Congenital Heart Disease, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons*

#### WRITING COMMITTEE MEMBERS

Carole A. Wames, MD, FRCP, FACC, FAHA, Co-Chair; Roberta G. Williams, MD, MACC, FAHA, Co-Chair;  
Thomas M. Bashore, MD, FACC; John S. Child, MD, FACC, FAHA; Heidi M. Connolly, MD, FACC;  
Joseph A. Dearani, MD, FACC\*; Pedro del Nido, MD; James W. Fasules, MD, FACC;  
Thomas P. Graham, Jr, MD, FACC†; Ziyad M. Hijazi, MBBS, MPH, FACC, FSCAI‡;  
Sharon A. Hunt, MD, FACC, FAHA; Mary Elta King, MD, FACC, FASE§;  
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Edward P. Walsh, MD, FACC¶; Gary D. Webb, MD, FACC¶

#### TASK FORCE MEMBERS

Sidney C. Smith, Jr, MD, FACC, FAHA, Chair; Alice K. Jacobs, MD, FACC, FAHA, Vice-Chair;  
Cynthia D. Adams, RSN, PhD, FAHA#; Jeffrey L. Anderson, MD, FACC, FAHA#;  
Elliott M. Antman, MD, FACC, FAHA\*\*†; Christopher E. Buller, MD, FACC;  
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Richard L. Page, MD, FACC, FAHA; Barbara Riegel, DNSc, RN, FAHA#; Lynn G. Tarkington, RN;  
Clyde W. Yancy, MD, FACC, FAHA



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procedure, only 45% of patients were free of neo-aortic autograft dilatation, but 90% had an increase in autograft root dimensions greater than 25%. However, dilatation did not always necessitate reoperation for aneurysm formation or increasing AR (343), and the use of a subcoronary Ross procedure results in stable root dimensions (344,345).

### 6.7. Recommendations for Key Issues to Evaluate and Follow-Up

#### CLASS I

1. Lifelong cardiology follow-up is recommended for all patients with aortic valve disease (AS or AR) (operated or unoperated; refer to Section 6.4, Recommendations for Evaluation of the Unoperated Patient). (Level of Evidence: A)
2. Serial imaging assessment of aortic root anatomy is recommended for all patients with BAV, regardless of severity. The frequency of imaging would depend on the size of the aorta at initial assessment: if less than 40 mm, it should be reimaged approximately every 2 years; if greater than or equal to 40 mm, it should be reimaged yearly or more often as progression of root dilation warrants or whenever there is a change in clinical symptoms or findings. (Level of Evidence: B)
3. Prepregnancy counseling is recommended for women with AS who are contemplating pregnancy. (Level of Evidence: B)
4. Patient referral to a pediatric cardiologist experienced in fetal echocardiography is indicated in the second trimester of pregnancy to search for cardiac defects in the fetus. (Level of Evidence: C)
5. Women with BAV and ascending aorta diameter greater than 4.5 cm should be counseled about the high risks of pregnancy. (Level of Evidence: C)
6. Patients with moderate to severe AS should be counseled against participation in competitive athletics and strenuous isometric exercise. (Level of Evidence: B)
7. Echocardiographic screening for the presence of BAV is recommended for first-degree relatives of patients with BAV. (Level of Evidence: B)

Progressive or recurrent AS, AR, or aortic enlargement may occur in the presence of a BAV. Patients with or without intervention should be followed up at least yearly for symptoms and findings of progressive AS/AR ventricular dysfunction and arrhythmia. This includes resting and stress ECGs to look for ischemic changes or arrhythmia; echocardiography-Doppler to monitor LV size/volume and systolic and diastolic function, aortic valve function, and aortic root size and anatomy; and 24-hour ambulatory ECG monitoring.

With or without intervention, both AS and AR are progressive lesions that may ultimately require surgical intervention. Prosthetic valve complications include endocarditis, thrombosis, pariprosthetic regurgitation with or without hemolysis, and obstruction related to pannus in growth. Patients who undergo the Ross procedure (placement of the native pulmo-

Patients who undergo the Bentall procedure (aortic root replacement with a composite valve and graft with coronary reimplantation) are also at risk for proximal coronary obstruction.

Congenital AS with a long-standing significant gradient can be associated with ventricular arrhythmias in adulthood, including the small possibility of sudden cardiac death (346). Patients should be monitored carefully for symptoms and should have regular ECGs, plus periodic ambulatory rhythm monitoring, to assist in early detection of arrhythmias (104,347).

#### 6.7.1. Reproduction

Most pregnancies with congenital AS are uncomplicated, but in those with severe AS, morbidity is higher, although deaths are still rare (348,349). Prepregnancy counseling is recommended. Referral to a fetal cardiologist is indicated in the second trimester because there is an increased risk of transmitting CHD to offspring. Delivery in all but the mildest of cases may be best accomplished at centers experienced with high-risk heart disease. Vaginal delivery is generally preferable to cesarean delivery except in the presence of obstetric contraindications or severe cardiac situations, such as aortic aneurysm, dissection, or critical AS, or in women who are undergoing anticoagulation (because of the risks of intracranial bleeding in the newborn). Delivery may be performed under controlled circumstances at approximately 38 weeks (provided fetal lung maturity is deemed sufficient) with appropriate monitoring of maternal heart rate, blood pressure, and fetal monitoring. Even though the 2007 AHA Scientific Statement on Prevention of Infective Endocarditis does not recommend routine prophylaxis for vaginal delivery or cesarean section, many obstetricians administer antibiotics at the time of rupture of membranes for women with aortic valve disease (74) (refer to Section 1.6, Recommendations for Infective Endocarditis, for additional information). Prepregnancy or prenatal evaluation and counseling in women with congenital aortic valve disease is essential to explore options and manage risks. The role of balloon valvuloplasty in the palliation of symptomatic pregnant women with AS requires further study, but it may be applied successfully if symptoms are refractory to medical therapy (348,350). There is no evidence that pregnancy accelerates progression of congenital AS or AR. In some cases, the drop in systemic vascular resistance that accompanies pregnancy may reduce the regurgitant fraction in AR (351).

#### 6.7.2. Activity/Exercise

Patients with moderate to severe AS who participate in competitive athletics risk sudden cardiac death, likely from arrhythmias; therefore, they should be strongly counseled against competitive athletics and strenuous isometric exercise. Patients with aortopathy should be similarly counseled about the risks of chest injury. Exercise and athletics have been addressed in the report of Task Force 2 on CHD of the 36th Bethesda Conference (49).





**Information  
Overload**

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the practice**

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**The “Gist”**

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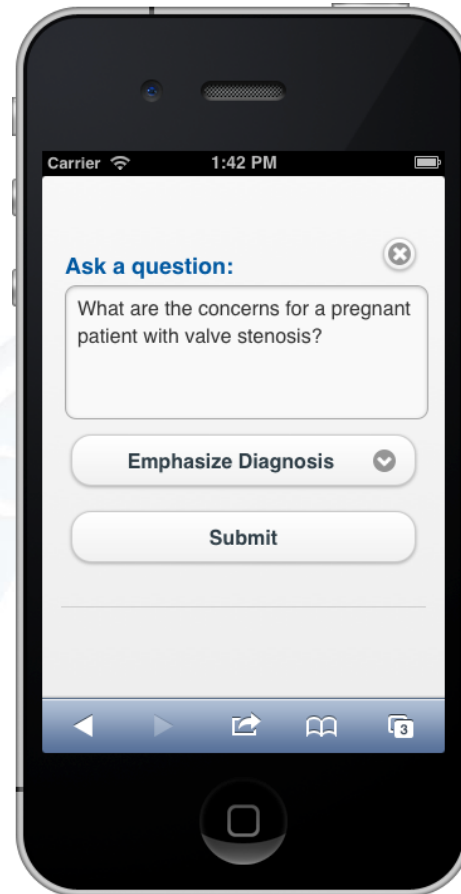
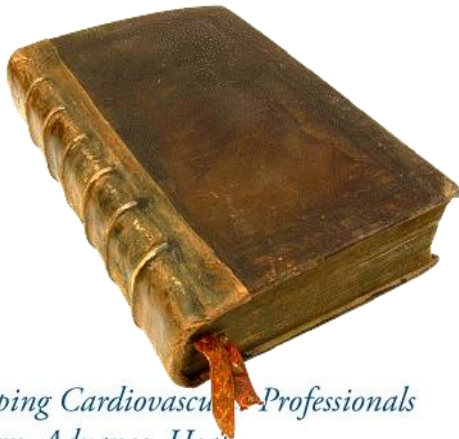
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incredibly valuable vetted  
knowledge of the guidelines  
and make them of optimal  
utility to cardiologists in the  
21<sup>st</sup> century?**



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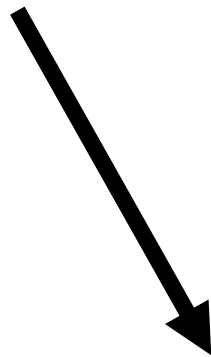
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guidelines  
differently**



**Organize  
guidelines  
differently**



**Knowledge “chunks”**



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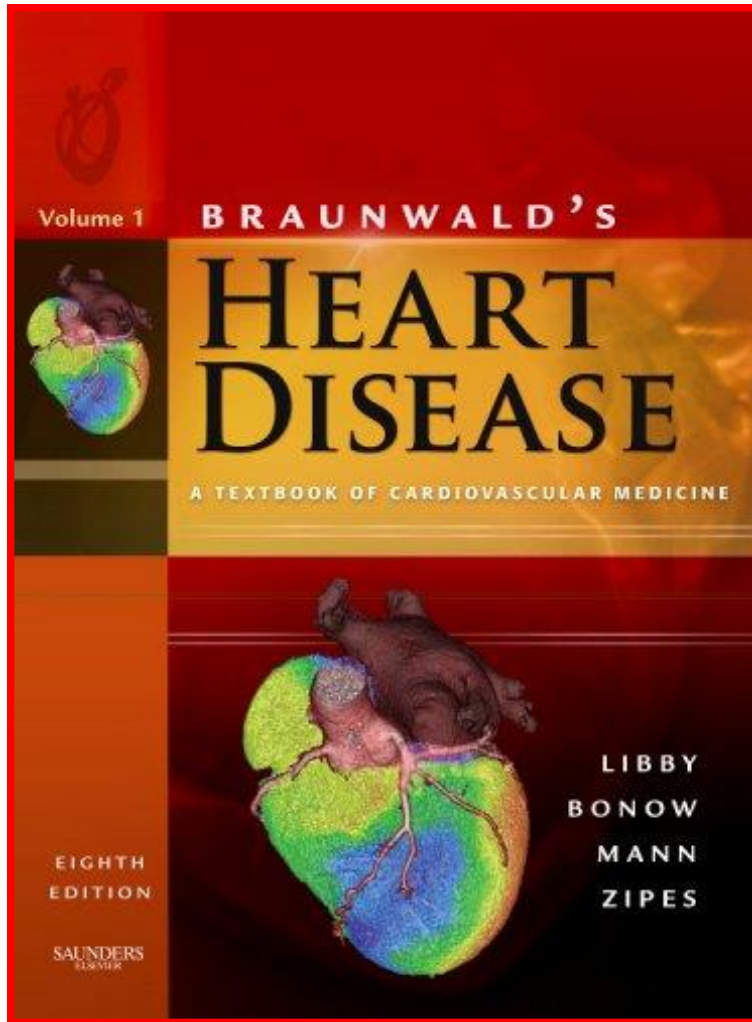
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**Create and organize  
knowledge content  
differently to meet the needs  
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# Textbook Writing Academic Cardiologists



Introduction  
Etiology  
Pathology  
Pathophysiology  
Signs and Symptoms  
EKG, CXR, lab testing  
Noninvasive imaging  
Invasive testing  
Natural history  
Medical therapy  
Interventions  
Surgery  
Etc.



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**Create taxonomy**  
**Based upon how clinicians think**

# Aortic stenosis

Diagnosis and testing

Medical therapy

Treatment Intervention



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# Create taxonomy

## Based upon how clinicians think

# Create evidence tables

## Based upon taxonomy

Table Supplement 25. Pregnancy and Prosthetic Valves Prior to LMWH (Section 12.3.2)

Study Name, Author, Year	Study Aim	Study Size (N)	Patient Population		Study Type	Type of Anticoagulation	Endpoints		Summary	Study Limitations
			Inclusion Criteria	Exclusion Criteria			Maternal	Fetal		
<a href="#">Shan, 2000 (201)</a> <a href="#">10647757</a>	Systematic review anticoagulation mechanical valves	1,234 pregnancies in 976 women	All pts with mechanical prosthesis—40 articles—treated with differing anticoagulation regimens 1966–1997	N/A	Systematic review of literature	1. Warfarin throughout 2. UFH 1 <sup>st</sup> trimester, then warfarin 3. UFH throughout pregnancy 4. No A/C	Maternal Death 1. 1.8% 2. 4.2% 3. 15% 4. 4.7%  Thromboembolic 1. 3.9% 2. 9.2% 3. 33% 4. 24%	Fetal anomalies 1. 6.4% 2. 3.4% 3. 0% 4. 3.3%  Fetal wastage 1. 33% 2. 26% 3. 43% 4. 20%	Reduction of thromboembolic events for mother greatest with warfarin throughout pregnancy, worse maternal outcome with heparin throughout pregnancy. Heparin in 1 <sup>st</sup> trimester reduces risk of fetopathic effects, but with increased risk of thromboembolic embolic events.	Retrospective systematic review—prior to LMWH use
<a href="#">Meschengieser, 1999 (202)</a> <a href="#">10377303</a>	Single center experience anticoagulation mechanical valves	92 pregnancies in 59 women	Consecutive unselected pregnancies between 1986–1997	N/A	Observational	1. Warfarin throughout pregnancy 2. UFH 1 <sup>st</sup> trimester, then warfarin 3. UFH throughout pregnancy 4. No A/C	Thromboembolic 1. 0.3 episodes/100 pt mo 2. 4.9 episodes/100 pt mo	Fetal wastage 1. 25% 2. 19%	Reduction of thromboembolic events for mother greatest with warfarin throughout pregnancy. No maternal deaths or valve thrombosis occurred in this study.	Retrospective review of small number pts—prior to LMWH use
<a href="#">Vitale, 1999 (203)</a> <a href="#">10334435</a>	Single center experience anticoagulation mechanical valves	58 pregnancies in 43 pts	Consecutive unselected pregnancies between 1987–1997	N/A	Observational	1. Warfarin throughout pregnancy A. Dose ≤5 mg vs. B. Dose >5 mg	Maternal Death None Valve thrombosis 2 pts	Fetal complications 1A. 4 SA and 1 GR (28/32 healthy babies) vs. 1B. 2 WE, 18 SA, 1 SB, 1 VSD (3/25 healthy babies)	First to show that fetal complications are dose-dependent, relatively safe if dose ≤5 mg	Retrospective review—only warfarin throughout was used
<a href="#">Salazar, 1996 (204)</a> <a href="#">3636556</a>	Single center experience anticoagulation mechanical valves	40 pregnancies in 37 pts	Single center experience of a prospective protocol using UFH subq during the 1 <sup>st</sup> trimester	N/A	Prospective cohort trial	All pts had subq UFH from 6–12 wk and then last 2 wk gestation	2 cases of massive thrombosis of a MVR tilting disk 1 death from GI bleeding during warfarin	37% spontaneous abortion 2.5% neonatal death No embryopathy	UFH is a poor anticoagulant and does not prevent massive thrombosis	Trial stopped after 2 events occurred
<a href="#">Sbarouni, 1994 (205)</a> <a href="#">3130033</a>	Questionnaire to all cardiac centers in Europe	214 pregnancies in 182 pts (133 with mechanical)	Questionnaire sent 1994 to all cardiac centers in Europe	N/A	Questionnaire data	N/A	6 maternal deaths (4 valve thrombosis, 1 cerebral embolism, 1 pulmonary edema) 13 valve thrombosis—10/13	No embryopathies in 36 women on warfarin Fetal outcome similar for warfarin vs.	Heparin is neither effective or safe for both fetus and mother with increased risk thromboembolism and bleeding	No detailed information on level of anticoagulation dose. Selection





**Create taxonomy**  
**Based upon how clinicians think**

**Create evidence tables**  
**Based upon taxonomy**

**Create knowledge chunks**  
**(concise, relevant, practical)**  
**Based upon taxonomy and evidence**

**Class IIa: Continuation of warfarin during the first trimester is reasonable for pregnant patients with a mechanical prosthesis if the dose of warfarin to achieve a therapeutic INR is less than or equal to 5 mg per day**



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**Create taxonomy**  
**Based upon how clinicians think**

**Create evidence tables**  
**Based upon taxonomy**

**Create knowledge chunks**  
**(concise, relevant, practical)**  
**Based upon taxonomy and evidence**

**Supporting text for each chunk (concise)**

**Link to References**

**Link to Figures**



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**Class IIa: Continuation of warfarin during the first trimester is reasonable for pregnant patients with a mechanical prosthesis if the dose of warfarin to achieve a therapeutic INR is less than or equal to 5 mg per day**

The optimal anticoagulant used for pregnant patients with mechanical prosthetic valves during the first trimester remains controversial. Oral anticoagulation with warfarin is overall the safest regimen for the mother, but there is an increased risk of embryopathy. Anticoagulation with UFH or LMWH has been recommended to avoid the risk of embryopathy, but is not as effective as warfarin in preventing thromboembolic events. It has been shown that the risk of embryopathy is dose-dependent, with a low risk (<3%) if the dose of warfarin is  $\leq 5$  mg per day. The risk of abortion and fetal loss are increased with any anticoagulant regimen, but may be similar in women exposed to oral anticoagulants versus heparin in the first trimester, especially at low doses of warfarin. Continuation of warfarin during the first trimester is reasonable after a full discussion with the patient and family regarding the risks and benefits when a therapeutic INR can be maintained with a daily warfarin dose of  $\leq 5$  mg.

*Supporting References:* (811, 812, 817, 818, 821, 824-827)



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## ACC/AHA Guidelines

ACC/AHA Guidelines for the Management of Patients with Valvular Heart Disease

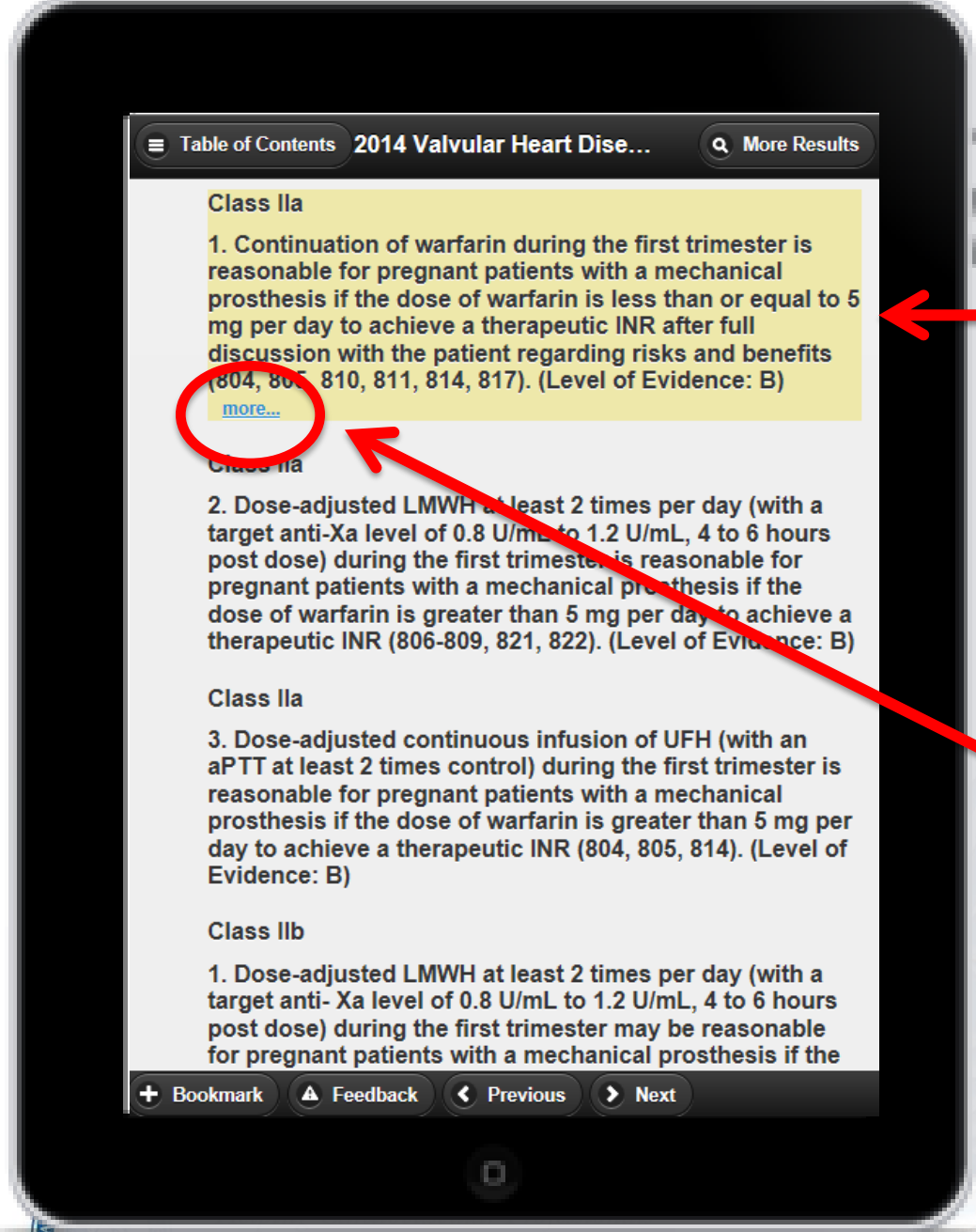
anticoagulation for mechanical valves during pregnancy x

Search

Type in  
“anticoagulation  
for mechanical  
valves during  
pregnancy”







Class IIa

1. Continuation of warfarin during the first trimester is reasonable for pregnant patients with a mechanical prosthesis if the dose of warfarin is less than or equal to 5 mg per day to achieve a therapeutic INR after full discussion with the patient regarding risks and benefits (804, 805, 810, 811, 814, 817). (Level of Evidence: B)

[more...](#)

Class IIa

2. Dose-adjusted LMWH at least 2 times per day (with a target anti-Xa level of 0.8 U/mL to 1.2 U/mL, 4 to 6 hours post dose) during the first trimester is reasonable for pregnant patients with a mechanical prosthesis if the dose of warfarin is greater than 5 mg per day to achieve a therapeutic INR (806-809, 821, 822). (Level of Evidence: B)

Class IIa

3. Dose-adjusted continuous infusion of UFH (with an aPTT at least 2 times control) during the first trimester is reasonable for pregnant patients with a mechanical prosthesis if the dose of warfarin is greater than 5 mg per day to achieve a therapeutic INR (804, 805, 814). (Level of Evidence: B)

Class IIb

1. Dose-adjusted LMWH at least 2 times per day (with a target anti-Xa level of 0.8 U/mL to 1.2 U/mL, 4 to 6 hours post dose) during the first trimester may be reasonable for pregnant patients with a mechanical prosthesis if the

Goes directly to the “knowledge byte” that is answers the question

Class Recommendation

Read “more” for supporting text and references



**Class IIa**

**1. Continuation of warfarin during the first trimester is reasonable for pregnant patients with a mechanical prosthesis if the dose of warfarin is less than or equal to 5 mg per day to achieve a therapeutic INR after full discussion with the patient regarding risks and benefits (804, 805, 810, 811, 814, 817). (Level of Evidence: B)**

[more...](#)

The optimal anticoagulant used for pregnant patients with mechanical prosthetic valves during the first trimester remains controversial. Oral anticoagulation with warfarin is overall the safest regimen for the mother, but there is an increased risk of embryopathy. Anticoagulation with UFH or LMWH has been recommended to avoid the risk of embryopathy, but is not as effective as warfarin in preventing thromboembolic events. It has been shown that the risk of embryopathy is dose-dependent, with a low risk (<3%) if the dose of warfarin is  $\leq 5$  mg per day. The risk of abortion and fetal loss are increased with any anticoagulant regimen, but may be similar in women exposed to oral anticoagulants versus heparin in the first trimester, especially at low doses of warfarin. Continuation of warfarin during the first trimester is reasonable after a full discussion with the patient and family regarding the risks and benefits when a therapeutic INR can be maintained with a daily warfarin dose of  $< 5$  mg (804, 805, 810, 811, 814, 817-820). [less...](#)

See Online Data Supplements 25 and 26 for more information on pregnancy.

**Class IIa**

+ Bookmark

Feedback

Previous

Next

**Supporting text  
Concise and  
relevant**

**Link to references  
Tables**



**Class IIa: Continuation of warfarin during the first trimester is reasonable for pregnant patients with a mechanical prosthesis if the dose of warfarin to achieve therapeutic INR is less than or equal to 5 mg per day**

Pregnancy

The optimal anticoagulant used for pregnant patients with mechanical prosthetic valves during the first trimester remains controversial. Oral anticoagulation with warfarin is overall the safest. Other, LMWH, and UFH are also used. Warfarin is associated with embryopathy, but this has been shown to be dose-dependent. The risk of abortion and fetal loss are increased with any anticoagulant regimen, but may be similar in women exposed to oral anticoagulants versus heparin in the first trimester, especially at low doses. Continuation of warfarin during the first trimester is reasonable after a full discussion of the risks and benefits when a therapeutic warfarin dose of  $\leq 5$  mg.

Valve Stenosis

Valve Regurgitation

Prosthetic Valve

Thrombotic Therapy

Intervention

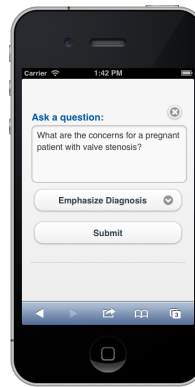
Supporting References: (811, 812, 817, 818, 821, 824-827)

Warfarin

LMWH

UFH





Point of Care Knowledge when you need it

## Knowledge Byte

**Class IIa: Continuation of warfarin during the first trimester is reasonable for pregnant patients with a mechanical prosthesis if the dose of warfarin to achieve a therapeutic INR is less than or equal to 5 mg per day**

The optimal anticoagulant used for pregnant patients with mechanical prosthetic valves during the first trimester remains controversial. Oral anticoagulation with warfarin is overall the safest regimen for the mother, but there is an increased risk of embryopathy. Anticoagulation with UFH or LMWH has been recommended to avoid the risk of embryopathy, but is not as effective as warfarin in preventing thromboembolic events. It has been shown that the risk of embryopathy is dose-dependent, with a low risk (<3%) if the dose of warfarin is ≤5 mg per day. The risk of abortion and fetal loss are increased with any anticoagulant regimen, but may be similar in women exposed to oral anticoagulants versus heparin in the first trimester, especially at low doses of warfarin. Continuation of warfarin during the first trimester is reasonable after a full discussion with the patient and family regarding the risks and benefits when a therapeutic INR can be maintained with a daily warfarin dose of ≤5 mg.

Supporting References: (811, 812, 817, 818, 821, 824-827)

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A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines

Developed in Collaboration With the American Association for Thoracic Surgery, American Society of Echocardiography, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons

#### WRITING COMMITTEE MEMBERS\*

Rick Nishimura, MD, MACC, FAHA, *Co-Chair*†  
Catherine M. Otto, MD, FACC, FAHA, *Co-Chair*†

Robert O. Bonow, MD, MACC, FAHA†  
Blase A. Carabello, MD, FACC†  
John P. Erwin, III, MD, FACC, FAHA†  
Robert A. Guyton, MD, FACC§  
Patrick T. O'Gara, MD, FACC, FAHA†

Carlos E. Ruiz, MD, PhD, FACC†  
Nikolaos J. Skubas, MD, FASE†  
Paul Sorajja, MD, FACC, FAHA#  
Thoralf M. Sundt, MD \*\*††  
James D. Thomas, MD, FASE††

ACC/AHA  
Guideline



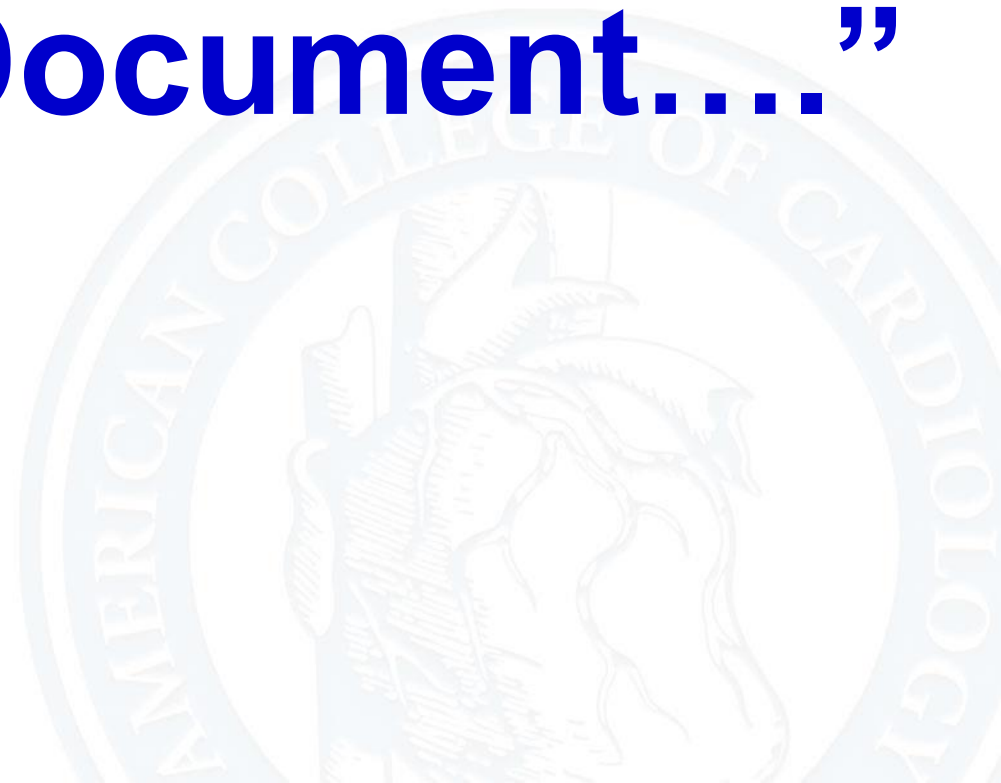
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On-line  
Education  
SAP's  
Live courses

# ACC AHA Guidelines

**“A Living Document....”**



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# New Knowledge

## Knowledge Byte

**Class IIa: Continuation of warfarin during the first trimester is reasonable for pregnant patients with a mechanical prosthesis if the dose of warfarin to achieve a therapeutic INR is less than or equal to 5 mg per day**

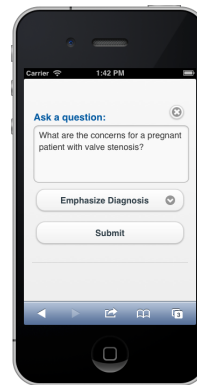
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Point of Care Knowledge when you need it

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ACC/AHA Guideline



Cardiosource On-line Education SAP's Live courses

# Future Vision

## “Executable Guidelines”

### Knowledge Byte

**Class IIa: Continuation of warfarin during the first trimester is reasonable for pregnant patients with a mechanical prosthesis if the dose of warfarin to achieve a therapeutic INR is less than or equal to 5 mg per day**

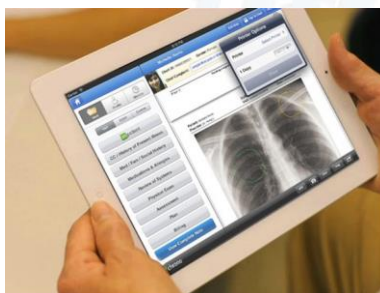
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Supporting References: (811, 812, 817, 818, 821, 824-827)

### Patient Specific Data



Electronic  
Health Record



Knowledge  
individualized to  
the patient  
To the physician  
To the patient



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# Future Vision

## “Executable Guidelines”

**To the physician : point of care “in the workflow”**  
Patient specific guideline “byte”

Positive  
Pregnancy  
test

Lab  
INR > 1.5

Drug  
Warfarin

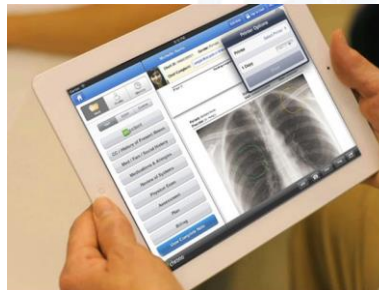
Dx  
Mitral  
stenosis

**Class Ila:** Continuation of warfarin during the first trimester is reasonable for pregnant patients with a mechanical prosthesis if the dose of warfarin to achieve a therapeutic INR is less than or equal to 5 mg per day

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Supporting References: (S11, S12, S17, S18, S21, S24-S27)

Alert  
knowledge  
byte



**Knowledge**  
**individualized to**  
**the patient**  
To the physician  
To the patient



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# Future Vision

## “Executable Guidelines”

### To the physician : point of care “in the workflow”

Patient specific guideline “byte”

Alerts : new onset AF, abnormal labs, drug interaction

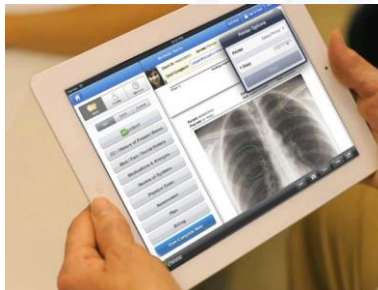
Clinical trials: patient specific inclusion criteria

### To the patient

Alerts : new onset AF, abnormal labs

Appointment : for urgent conditions

Home monitoring: rhythm, weight, BP



**Knowledge**  
**individualized to**  
**the patient**

To the physician  
To the patient



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# Data Modeling for Information Re-usability

- **Current model supports document interchange**
- **Future models should support knowledge consumption**
  - **Living documents/change management**
  - **Search engines**
  - **Consumable/relevant chunks of information (Point-of-Care)**
  - **Mobile and voice-based applications**
  - **Question answering – “semantic analysis”**
  - **Executable knowledge - EMR integration**

