



# Determining the Optimal Route of Hysterectomy for Benign Indications: a Clinical Decision Tree Algorithm

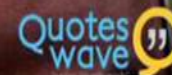
John B. Gebhart, MD, MS

May 17, 2019

# Disclosures

- UroCure – Advisory Board
- UpToDate – Royalties
- Elsevier - Royalties

**“TOMORROW  
HOPE WE HAVE LEARNED  
SOMETHING FROM  
YESTERDAY”**



# Objectives

- Background
- Retrospective Algorithm
- Design and Preparation of Prospective Algorithm
  - Deviations and exclusion criteria
  - Optimizing documentation
  - 3-D pelvic models
- Prospective Algorithm Results

# Background of Project

- ACOG
  - Vaginal route preferred
  - $\leq 12$  week size
  - Nulliparity not a contraindication
- Surgical approach is non-standardized
- Surgical trends
- Dr. Kovac algorithms

Obstet Gynecol. 2009 Nov; 114(5)

Morgan, et al. Am J Obstet Gynecol. 2018 Apr;218(4)

Kovac, et al. Am J Obstet Gynecol. 2002 Dec;187(6):1521-7.

Burkett, et al. Female Pelvic Med Reconstr Surg. 2011 Sep; 17(5)

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# Phase I: Retrospective Algorithm

# Objectives

- Primary Aims
  - Create clinical algorithm to determine optimal route of hysterectomy
  - Retrospectively apply the algorithm to a cohort who underwent hysterectomy
  - Outcomes when algorithm was followed vs deviated
- Secondary Aims
  - Evaluate effect of robotic surgery on practice patterns
  - Identify cost implications

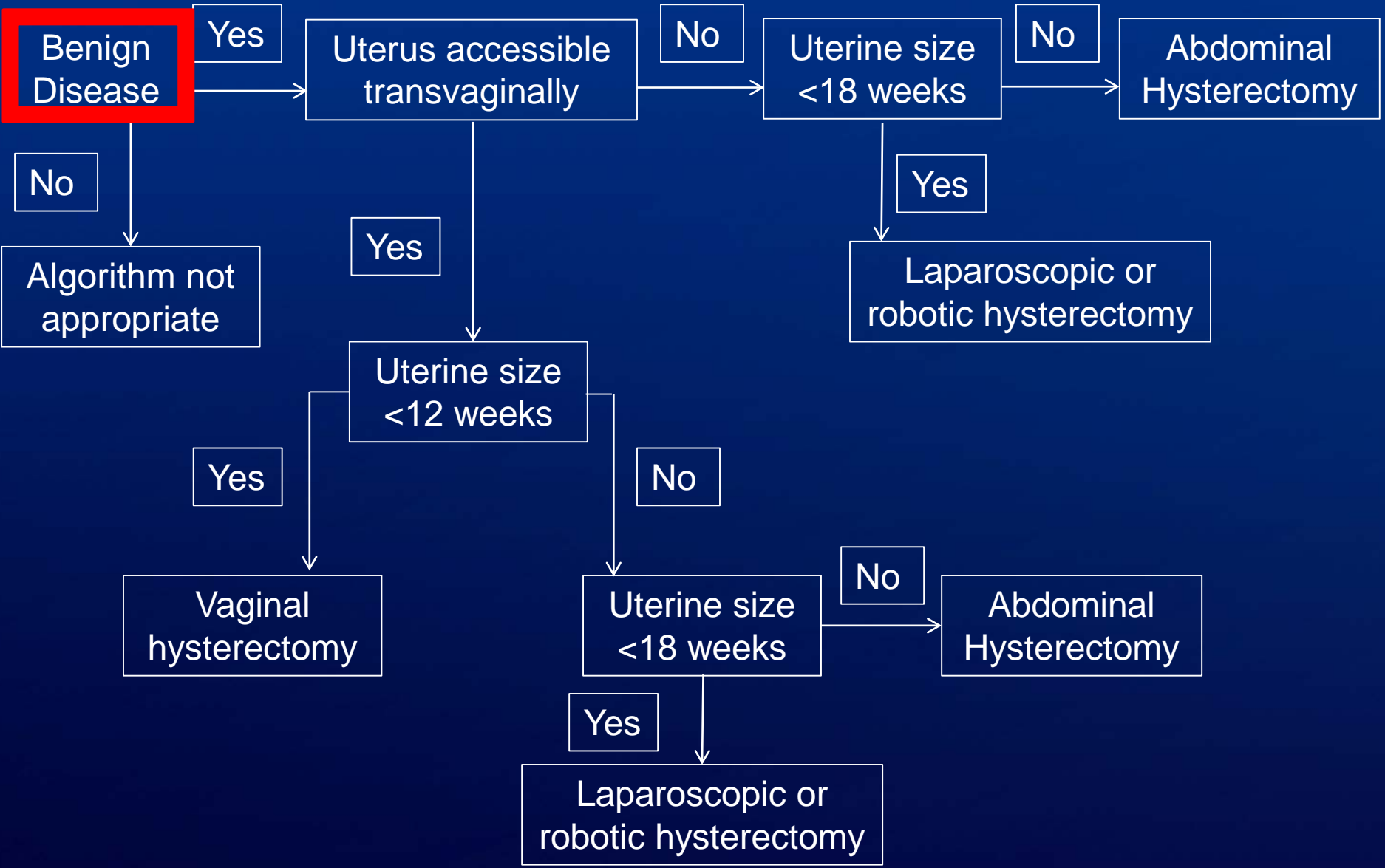
# Methods

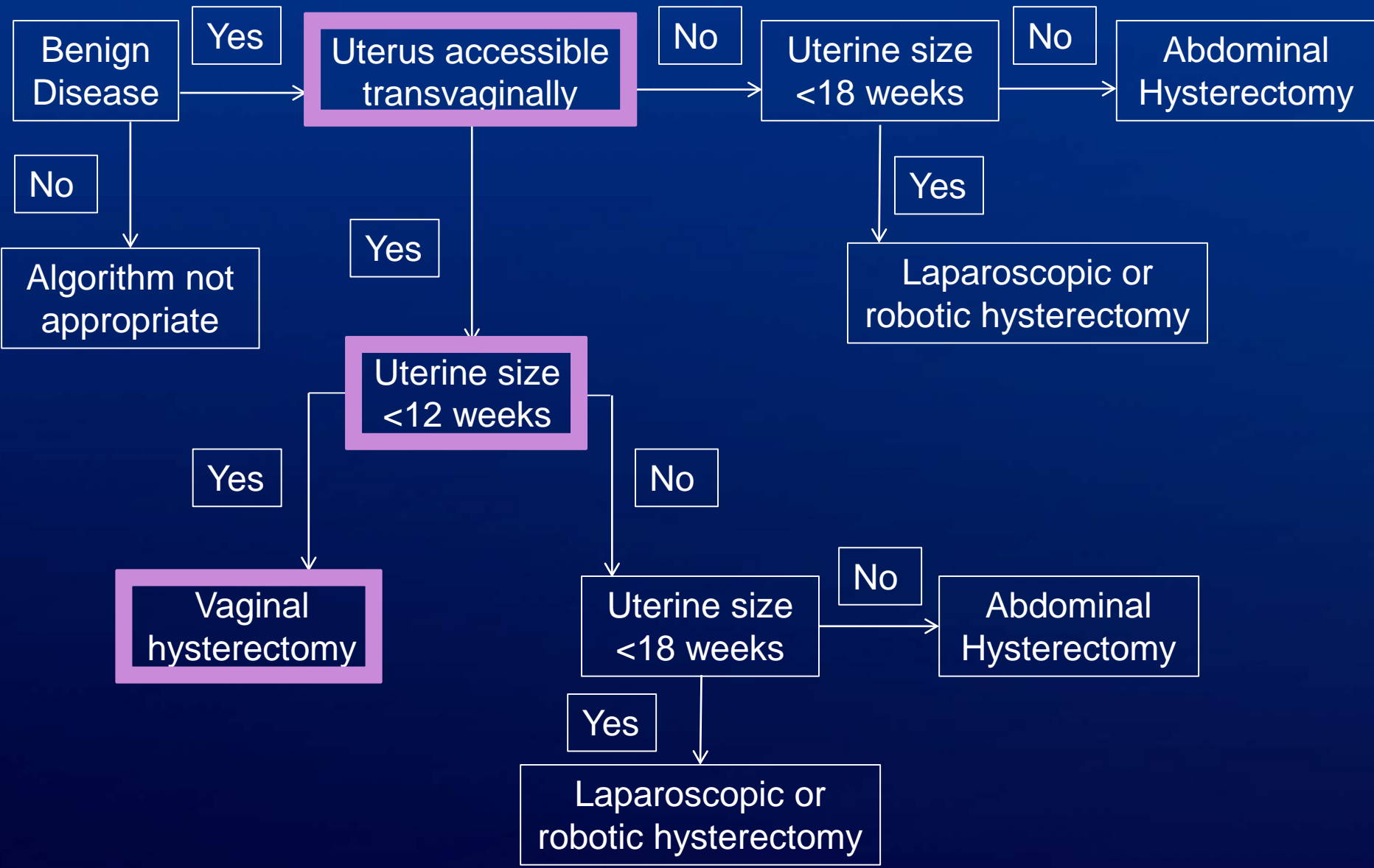
- Modified existing algorithm\*
  - Vaginal access to uterus
  - Uterine size

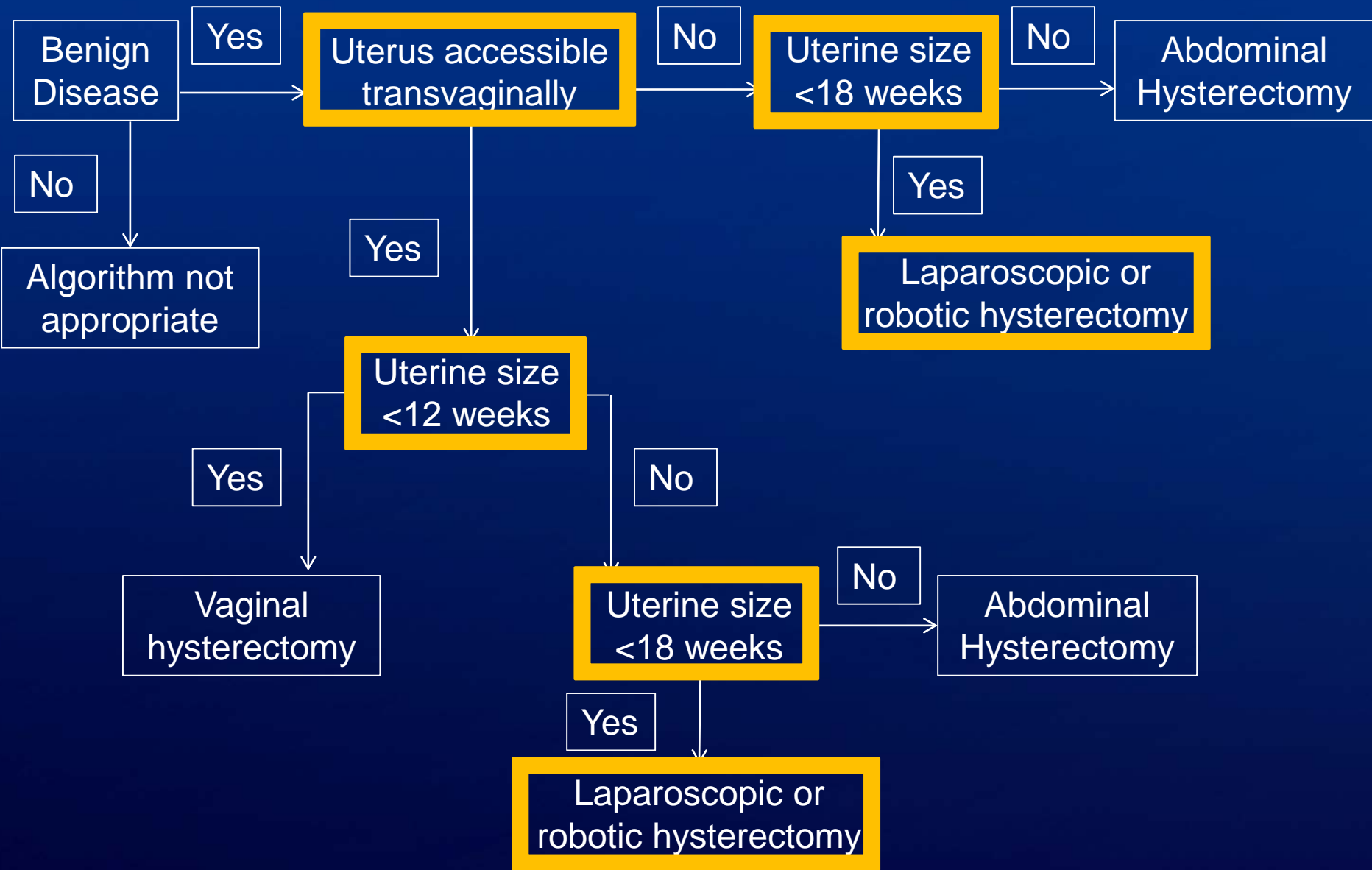


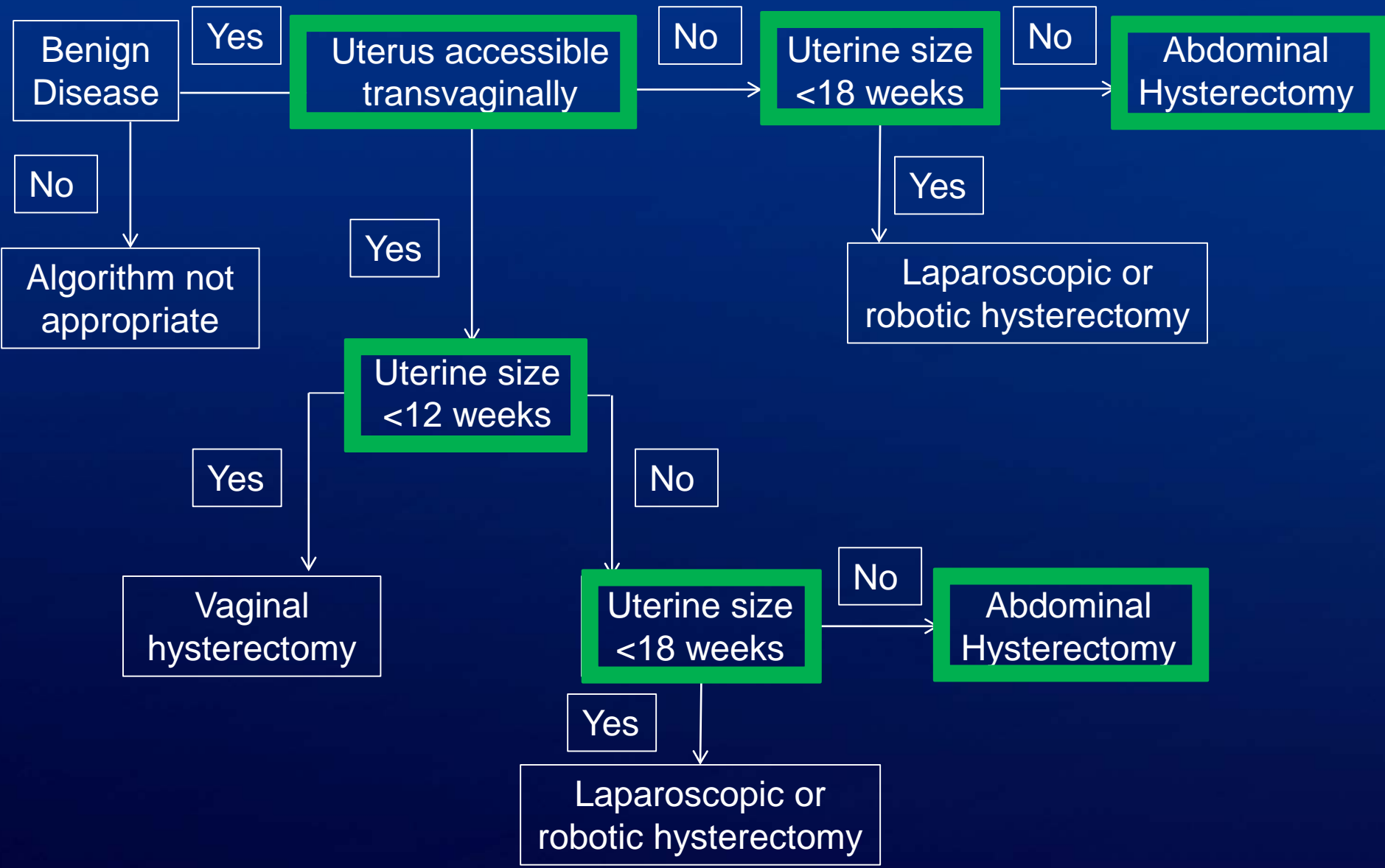
## Exclusion Criteria

Adnexal disease as primary indication	Mesh-related surgery or excision
Adnexal torsion	Müllerian or uterine anomalies
Age < 18 years old	Ovarian, fallopian tube, or peritoneal cancer
Cervical cancer > stage 1A1	Pelvic kidney
Cesarean hysterectomy	Planned umbilical hernia repair affecting route
Concomitant anti-incontinence procedures	Planned appendectomy, cholecystectomy or bowel surgery
Did not consent for research	Radical hysterectomy
Emergent hysterectomy	Risk-reducing surgery (ie BRCA+)
Endometrial hyperplasia > complex	Tubo-ovarian abscess
Multiple cone excisions, no available cervical tissue	Uterine cancer or suspicion for sarcoma









# Methods

- Cohorts
  - 2009-2013 (Cohort A)
  - 2004-2005 (Cohort B)
- Expected surgical route determined by applying algorithm

# Methods

- Statistical analysis
  - Categorical:  $\chi^2$  or Fisher exact test
  - Ordinal: Wilcoxon rank sum test
  - Continuous: 2-sample  $t$  test
  - Postoperative health: Logistic Regression models
    - UTI
    - SSI
    - Accordion Classification grade  $\geq 3$
- Cost estimates

Strasberg, et al. Ann Surg. 2009;250(2):177-86  
Woelk, et al. Obstet Gynecol 2014 Feb;123:255-62

# Results – Practice Patterns

- Expected Vaginal Route
  - Cohort B (2004-2005), N = 305
    - 15.1% deviation
  - Cohort A (2009-2013), N = 743
    - 25.8% deviation



# Expected Vaginal Route

	Actual Route Performed			P value (VH vs RH)
	Vaginal (N = 551)	Robotic (N = 154)	Abdominal (N = 38)	
Vaginal parity	500/550 (90.9)	65/153 (42.5)	20/38 (52.6)	<0.001
Cesarean Delivery	72/550 (13.1)	60/153 (39.2)	13 (34.2)	<0.001
OR time, median (IQR)	59 (43, 82)	141 (106, 168)	70 (60, 95)	<0.001
UTI	22/531 (4.1)	12/149 (8.1)	3/36 (8.3)	0.05
SSI	1/531 (0.2)	7/149 (4.7)	0/36 (0.0)	<0.001
Intraoperative route conversion	5 (0.9)	2 (1.3)	---	---

No significant difference in: postoperative blood transfusion, ASA score, overall postoperative complications, Accordion grade 3+ complications, hospital readmission

# Multivariable Analysis: SSI

	Adjusted OR (95% CI)	P Value
Operative time	1.51 (1.02-2.24)	0.04
Route of Hysterectomy		0.006
Vaginal	Reference	
Abdominal	13.6 (2.77-66.74)	
Robotic	7.50 (1.52-37.06)	

UTI: No independent predictors identified

# Multivariable Analysis: Accordion Grade 3+ Complications

	Adjusted OR (95% CI)	P Value
Route of Hysterectomy		0.009
Vaginal	Reference	
Abdominal	4.58 (1.58-13.33)	
Robotic	3.41 (1.39-8.36)	

# Results – cost implications

- Unadjusted mean cost\*
  - Vaginal: \$10,318
  - Robotic: \$14,402
  - Abdominal: \$15,079
- Expected vaginal route, Cohort A (2009-2013)
  - 30 hysterectomies abdominal
  - 154 hysterectomies robotically
- Total cost savings if followed algorithm ~ \$800,000

# Strengths and Limitations

- Strengths
  - Large cohort
  - 13 surgeons
  - Historical data from Cohort B (2004-2005)
- Limitations
  - Retrospective
  - Fellowship trained surgeons

# Conclusion

- Robotic surgery initiation:
  - 20% absolute reduction of laparotomy
  - 10% absolute reduction of VH
- Using algorithm, VH associated with lower infection rates, operative times and costs
- Utilize vaginal route when feasible

*Original Research*

# Determining Optimal Route of Hysterectomy for Benign Indications

*Clinical Decision Tree Algorithm*

*Jennifer J. Schmitt, DO, Daniel A. Carranza Leon, MD, John A. Occhino, MD, Amy L. Weaver, MS,  
Sean C. Dowdy, MD, Jamie N. Bakkum-Gamez, MD, Kalyan S. Pasupathy, PhD, and John B. Gebhart, MD*

Obstet Gynecol. 2017 Jan;129(1):130-138.

# Phase II: Design and Implementation of Prospective Algorithm



# Deviations

- Pathology uterine size > estimated size
- Endometriosis
- Laparotomies
- Nulliparity
  
- Adnexal cyst >4 cm
- Gender confirming surgery

# Exclusion Criteria

Primarily adnexal indication or benign adnexal mass >4 cm ★	Mesh-related surgery or excision
Adnexal torsion	Müllerian or uterine anomalies
Age < 18 years old	Ovarian, fallopian tube, or peritoneal cancer
Cervical cancer > stage 1A1	Pelvic kidney
Cesarean hysterectomy	Planned umbilical hernia repair affecting route
Concomitant anti-incontinence procedures	Planned appendectomy, cholecystectomy or bowel surgery
Gender confirming surgery ★	Radical hysterectomy
Emergent hysterectomy	Risk-reducing surgery (ie BRCA+)
Endometrial hyperplasia > complex	Tubo-ovarian abscess
Endometriosis ★	Uterine cancer or suspicion for sarcoma

Hysterectomy indicated for Benign Disease

Uterine size  $\leq 12$  w (280 g)

And

$\leq 1$  C-section/laparotomy

And

Adequate vaginal caliber,  
mobility and descent in  
office

Uterine size 13-16 w

Or

$\geq 2$  C-section/laparotomy

Or

Inadequate vaginal  
caliber, mobility and  
descent in office

Uterine size  $\geq 17$  w

Laparoscopic,  
Robotic, or Abdominal  
Hysterectomy

Exam Under Anesthesia

Vaginal Hysterectomy

Yes

Uterus descends to  
halfway down vagina and  
adequate vaginal caliber

No

Laparoscopic or  
Robotic Hysterectomy

Hysterectomy indicated for Benign Disease

Uterine size  $\leq 12$  w (280 g)  
And  
 $\leq 1$  C-section/laparotomy  
And  
Adequate vaginal caliber,  
mobility and descent in  
office

Vaginal Hysterectomy

Yes

Uterine size 13-16 w  
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 $\geq 2$  C-section/laparotomy  
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Inadequate vaginal  
caliber, mobility and  
descent in office

Exam Under Anesthesia

Uterus descends to  
halfway down vagina and  
adequate vaginal caliber

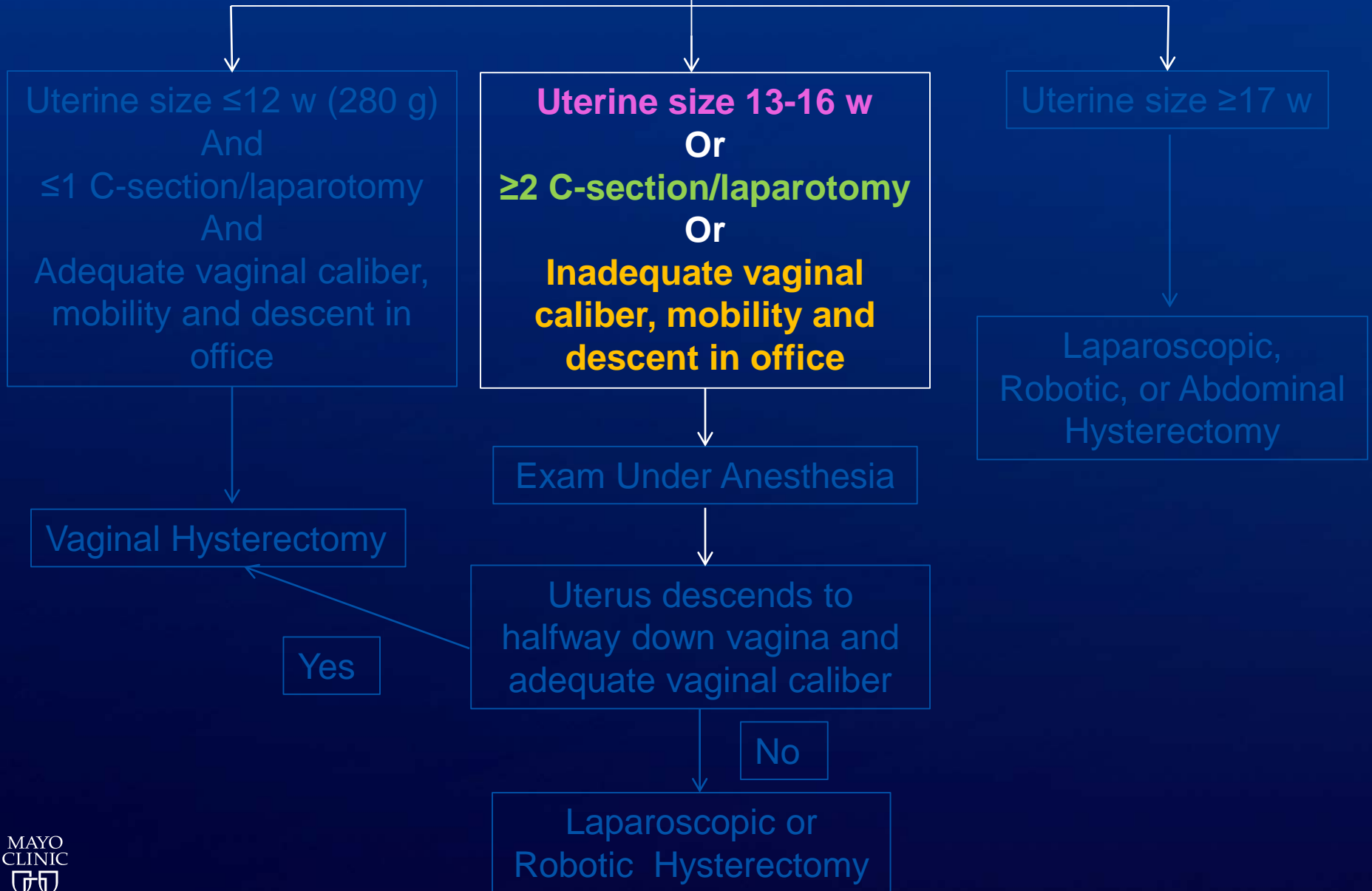
No

Laparoscopic or  
Robotic Hysterectomy

Uterine size  $\geq 17$  w

Laparoscopic,  
Robotic, or Abdominal  
Hysterectomy

# Hysterectomy indicated for Benign Disease



# Hysterectomy indicated for Benign Disease

Uterine size  $\leq 12$  w (280 g)  
And  
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Adequate vaginal caliber,  
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Uterine size  $\geq 17$  w

Laparoscopic,  
Robotic, or Abdominal  
Hysterectomy

**Exam Under Anesthesia**

Vaginal Hysterectomy

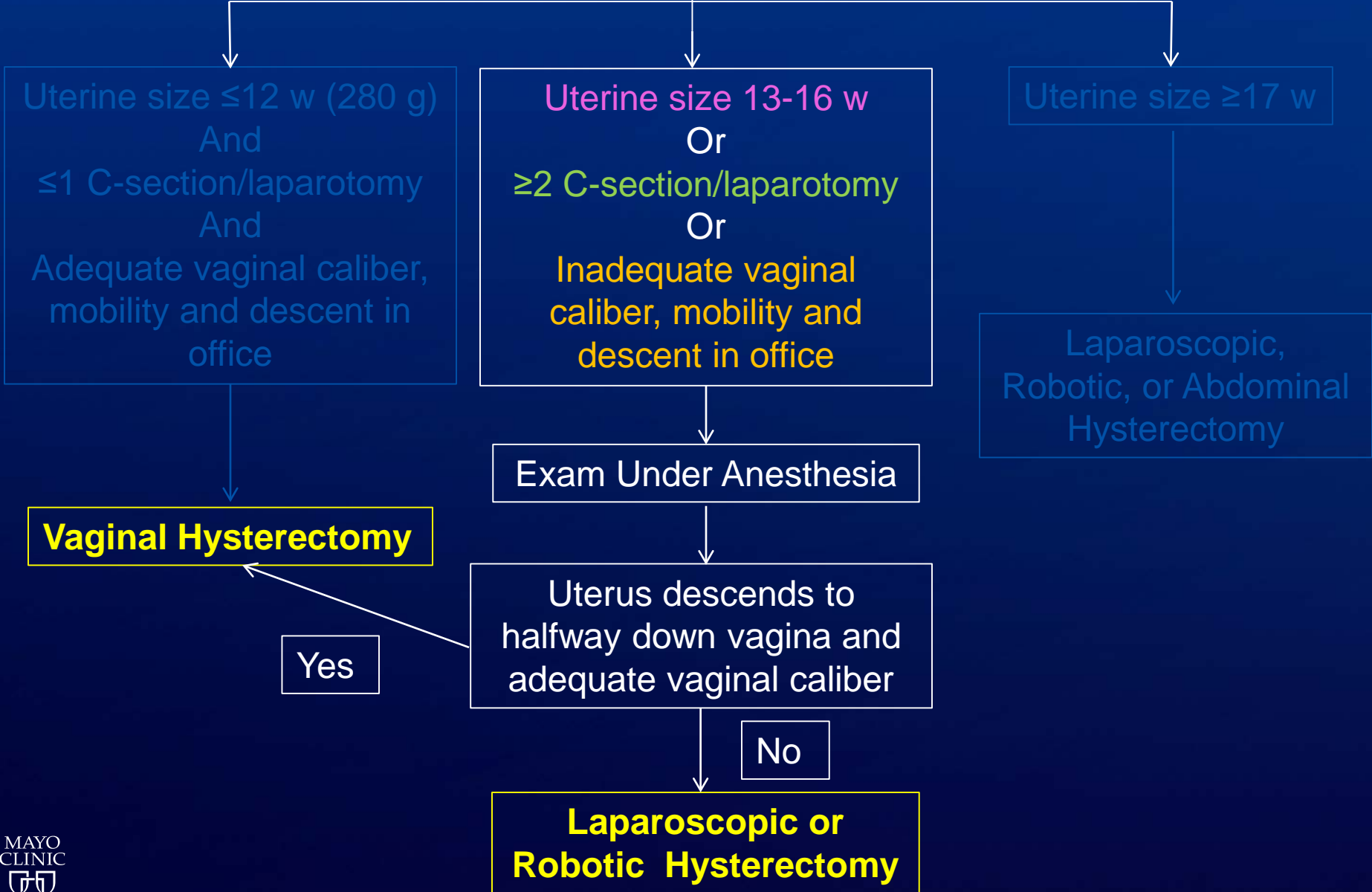
Yes

**Uterus descends to  
halfway down vagina and  
adequate vaginal caliber**

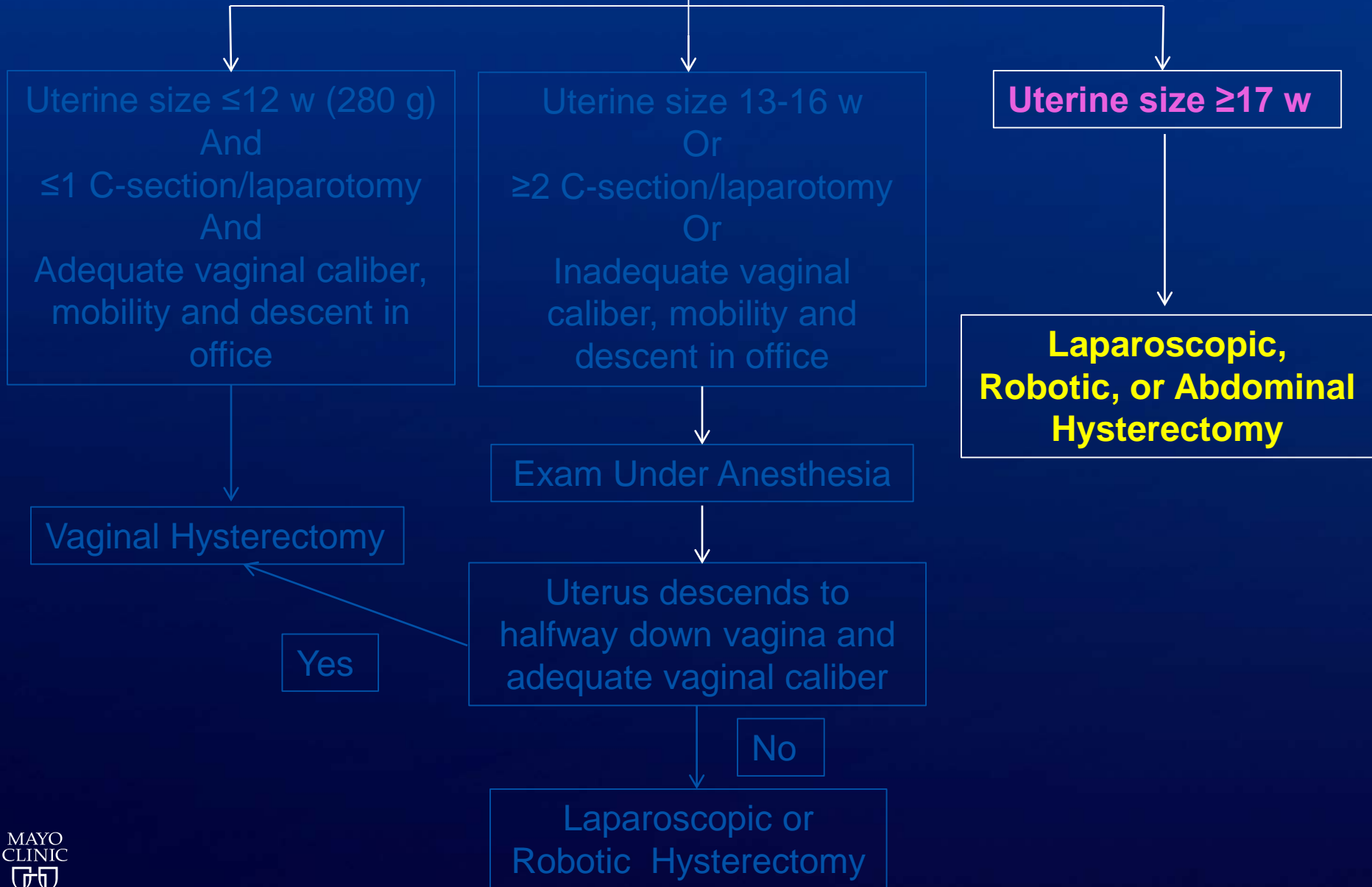
No

Laparoscopic or  
Robotic Hysterectomy

Hysterectomy indicated for Benign Disease



# Hysterectomy indicated for Benign Disease





# Standardizing Exam Documentation

- 2004-2005
  - 497 total patients (248.5/year)
    - 24 documentation issues (4.8%)
- 2009-2013
  - 1335 total patients (267/year)
    - 121 documentation issues (9.1%)

# Prospective Algorithm

## \*\*\*Consultant performs exam

### Office dictation standardization

- Uterine size: weeks of gestation (<8 or normal, 10, 12, 14, 16, 18, 20, 22 weeks...)
- Vaginal Caliber:
  - narrow or adequate
- Uterine/cervix location:
  - high or normal/prolapsed
- Uterine mobility:
  - mobile or not mobile

# Prospective Algorithm

## \*\*\*Consultant performs exam if EUA

### Office dictation standardization

- Uterine size: weeks of gestation (<8 or normal, 10, 12, 14, 16, 18, 20, 22 weeks...)
- Vaginal Caliber:
  - narrow or adequate
- Uterine/cervix location:
  - high or normal/prolapsed
- Uterine mobility:
  - mobile or not mobile

### EUA dictation standardization

- Under anesthesia
  - Bimanual assess caliber and descensus
    - Stirrups
  - If unsure:
    - Weighted speculum
    - 2 tenaculums + traction
- Dictate in operative note
  - Uterine size (weeks gestation)
  - Vaginal caliber
  - Uterine descensus/mobility

# 3-D Models for Uterine Size Estimates

- Collaboration with Radiology department at St. Mary's 3-D printer lab
- Mayo 12 and Eisenberg 4A
- Pelvic girdle with bladder, vagina and abdominal layers
  - Interchangeable uteri: 100 g, 280 g, 500+ g



# Phase III: Prospective Algorithm

# Introduction and Implementation

- Gynecologic Surgery Division Meetings
  - Reviewed Retrospective Results
  - Introduce Prospective Algorithm
    - Pelvic models
  - Review Prospective Algorithm
- November 23, 2015 – December 31, 2018

Hysterectomy indicated for Benign Disease

55.3%

Uterine size  $\leq 12$  w (280 g)  
And  
 $\leq 1$  C-section/laparotomy  
And  
Adequate vaginal caliber,  
mobility and descent in  
office

29.9%

Uterine size 13-16 w  
Or  
 $\geq 2$  C-section/laparotomy  
Or  
Inadequate vaginal  
caliber, mobility and  
descent in office

14.8%

Uterine size  $\geq 17$  weeks

Laparoscopic,  
Robotic, or Abdominal  
Hysterectomy

Vaginal Hysterectomy

Exam Under Anesthesia

15.9%

Uterus descends to  
halfway down vagina and  
adequate vaginal caliber

Yes

71.2%

No

14.0%

Laparoscopic or  
Robotic Hysterectomy

Expected Route per Algorithm	Actual Route performed			
	Vaginal	Abdominal	Robotic	Total (%)
Vaginal	170	2	30	202 (55.3)
Abd/Robotic/Lap	1	38	15	54 (14.8)
EUA then vaginal	41	2	15	58 (15.9)
EUA then robotic	6	2	43	51 (14.0)
Total (%)	218 (59.7)	44 (12.0)	103 (28.2)	365 (100)

Adherence to algorithm when TVH was expected = 170/202 (84.2%)

Adherence when TVH+ EUA-TVH expected = 211/260 (81.2%)

Gray: expected route = actual route

Red: Actual route more invasive than expected (deviation)

Green: Actual route less invasive than expected (no deviation)

Blue: EUA performed and TVH could not be performed



# Vaginal Hysterectomy

- Outcomes
  - 0 route conversion
  - 3 intraop complications (cystotomy, 1.8%)
  - 5 transfusions (2.9%)
  - 10 UTIs (5.9%)
  - 2 Accordion grade 3+ (1.2%)
    - Return to OR
      - Bleeding from gonadal vessels then pelvic abscess requiring IR drain
      - Acute blood loss anemia – found a contained retroperitoneal hematoma
  - Nearly 95% discharged by 24 hours

# Deviations when VH Expected

- N = 49 (13.4%)
  - 16 nulliparous (32.7%)
  - 13/48 (27%) 1+ cesarean delivery
  - No route conversions, intraop complications, or transfusions
  - 2 UTI (4.4%), 1 port site cellulitis (2.2%)
  - 1 Accordion grade 3+
    - Return to OR for ureteral injury
  - 86% discharged within 24 hours

# Conclusion

- Algorithm increased VH rate from 74 to 84%
- 100% of TVH group were successfully completed vaginally
- 95% of EUA-TVH group were successfully completed vaginally
- Algorithm can be used to identify straight forward vs complex cases
- Algorithm may increase the rate of VH and lower health care costs



# Questions & Discussion