



## The Modern Hybrid OR

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## Disclosures

- WL Gore – Consultant, Speaker
- Cook Medical – Consultant
- Endologix – Medical Advisory Board
- Fivos/Astute Imaging – Consultant
- GE Healthcare – Consultant
- Siemens Healthineers – Medical Advisory Board




## Dartmouth Hybrid ORs

- GE Allia (2022)




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- Siemens artis pheno (2021)






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- GE Allia (2022)
- Siemens artis pheno (2021)
- Philips Azurion (2020) – cath lab



## Access to 3 Different Machines

- No single machine is perfect
  - Support
  - Hardware
  - Software
  - Choice may depend on institutional financial situation
- Trainee preparation for future practice



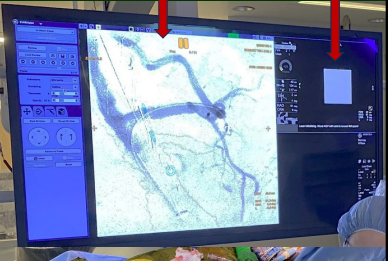
## Considerations setting up Hybrid OR

- Radiation Safety
- Capability
- Efficiency



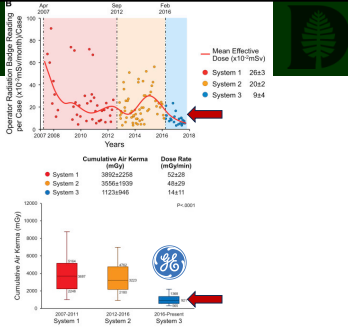
## Radiation Safety

- Onlay Fusion
- Digital Zoom
  - GE Allia
  - Philips Azurion
- Digital Enhancement
  - GE Vision App



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System	Cumulative Air Kerma (mGy)	Dose Rate (mGy/min)
System 1	3852,2258	62,28
System 2	3556,1559	48,23
System 3	1123,945	14,11

*Trenorio ER, Odenrich GS, et al. J Vasc Surg. 2019 Apr;69(4):1045-1058.e3*

## Radiation Safety

- Arm Elevation

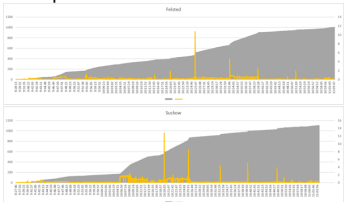


Variable	Arm elevation		P-value
	No (n = 102)	Yes (n = 42)	
Radiation, mSv	500 ± 189	238 ± 95	.01
Fluoroscopy time, minutes	56 ± 23	56 ± 19	.64
Contrast volume, mL	150 ± 58	149 ± 42	.85
Branchial plexus injury	0/101	0/42	1.00


*Pajori A, Zettervall S, et al. J Vasc Surg. 2023 Apr;77(4):991-996*

## Radiation Safety


- Use Real-Time Dosimetry to study individual practice patterns and improve intra-op behaviors



## Radiation Safety



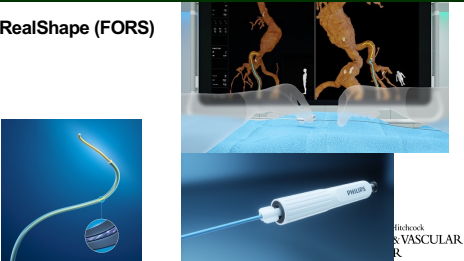
**Dartmouth OR 14**  
Mean Air Kerma  
4-vessel FEVAR 2022/2023 **3.8 Gy**



**Dartmouth OR 15**  
Mean Air Kerma  
4-vessel FEVAR 2022/2023 **0.9 Gy**

### Adjuncts to limit ionizing radiation

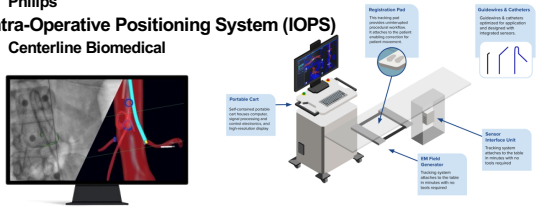
- Fiber Optic RealShape (FORS)
  - Philips



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### Adjuncts to limit ionizing radiation


- Fiber Optic RealShape (FORS)
  - Philips
- Intra-Operative Positioning System (IOPS)
  - Centerline Biomedical



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### Adjuncts to limit ionizing radiation

- Fiber Optic RealShape (FORS)
  - Philips
- Intra-Operative Positioning System (IOPS)
  - Centerline Biomedical
- AI Aortic mapping and fusion
  - CYDAR Medical



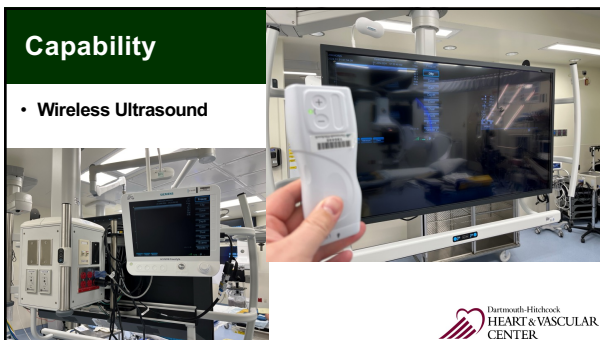
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### Considerations setting up Hybrid OR

- Radiation Safety
- Capability

### Capability

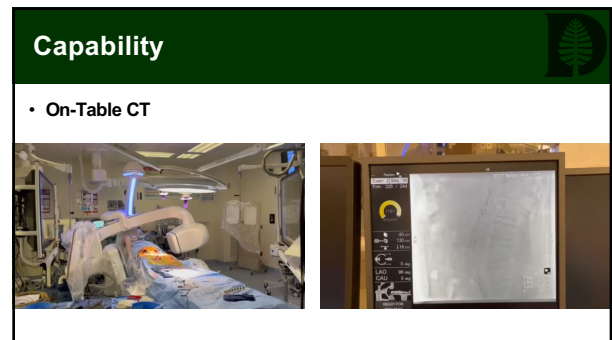
- Wireless Ultrasound



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### Capability

- On-Table CT



## Capability

- Software Packages

Preparation Registration Deployment Assessment

EVAR Case Flow steps

## Capability

- Software Packages

**Negotiate into original capital request**

**Difficult to obtain funding for later add-ons**

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- Radiation Safety
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- Efficiency

## Efficiency

- Extensive Planning
  - Contractors
  - Hybrid OR supplier
  - AV integration
  - Booms, Lights
  - Virtual models
- Weekly team meetings during construction

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**Central Figure = Owner = You!**

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- Layout
  - Ingress/Egress
  - Backtable work
  - Device Storage
  - Anesthesia
  - Neuromonitoring

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- Layout
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  - Backtable work
  - Device Storage
  - Anesthesia
  - Neuromonitoring
  - Table Controls
  - Shielding/Lights
  - Rad Tech Station



### Considerations setting up Hybrid OR

	 Allia	 Pheno	 Azurion
Digital Zoom	Yes	No	Yes
Mounting	Wheeled	Floor	Ceiling
Integrated Table Cradling	No	Yes	Yes
C-arm position	Off-set	Straight	Straight
Planning and guidance software	Yes	Yes	Yes
On-Table CT	Yes	Yes	Yes
FORS	No	No	Yes
Centerline Biomedical IOPS	Yes	Yes	Yes
Cydar	Yes	Yes	Yes

### Summary

- Radiation Safety**
  - Digital zoom, digital enhancement/post-processing
  - Arms elevated
  - Shielding
  - Live dosimetry to evaluate behaviors
- Capability**
  - Various software packages for fusion, guidance, support
  - Consideration of radiation reduction adjuncts
- Efficiency**
  - Integral involvement of vascular surgeon (owner) in planning and construction
  - Complexity of layout centered around workflow
  - Visit a site to see hybrid setup in action

