

The Catheter R&D Masterclass | Program Outline Eyedea Medtech Education

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Location: Workshops can be hosted at our dedicated facility (Westport, Mayo, Ireland), your facility, or a local hotel / university / venue.

Participant Limits: We strongly recommend 6-15 attendees. But can cater for up to 20 participants, if required.

Note: With more participants, the stronger voices in the room become dominant and interaction from other participants has a tendency to drop.

Background/experience: This workshop was created to advance and support engineers with 30+ years of experience. However, it was designed to be delivered to everyone, including non-technical staff such as sales teams, chemists, CEOs, investors, clinicians, and students.

Duration: 2 days / 8 hours per day. 4 x 1.5-hour chapters per day (timelines adjusted based on proposed start time).

	Day 1	Day 2
9:00 - 10:30	Introduction to Catheter Technologies	Catheter Design & Manufacturing Strategies
11:00 -12:30	Liners and Mandrels	
12:30 - 13:30	<i>Lunch</i>	
13:30 - 15:00	Reinforcement Technologies	Prototyping & Hands-On Build
15:30 - 17:00	Polymer Layers, Heat Shrinks, and Sterilisation	
		Future of Medtech

Executive Summary:

This two-day Masterclass provides a structured, end-to-end understanding of catheter-based medical devices, from internal architecture through to scalable production.

Following Eyedea’s immensely successful engaging education methodology, participants examine catheter systems layer by layer to develop a comprehensive understanding of how material selection and structural design directly influence device performance and manufacturing pathways. The program connects engineering theory with real-world manufacturing constraints across a wide scope of catheter constructs.

On day two, learning transitions into hands-on prototyping, where participants build an introducer sheath to apply reinforcement, material, and lamination principles in practice.

The workshop equips Medtech professionals of all backgrounds with a practical design framework, enabling more confident decision-making, improved device / product performance, and more efficient development cycles in regulated medical device environments.

Detailed Agenda of The Catheter R&D Masterclass

Day 1 — Core Catheter Architecture & Materials Science

Chapter 1: Introduction to Catheter Technologies

Entering the engineering foundations of catheter-based medical devices.

Objective: Establish a shared technical baseline for catheter design, enabling participants to understand how historical evolution, clinical application, and engineering constraints shape modern devices.

Key topics covered

- Historical evolution of catheter technologies and clinical drivers
- Core catheter categories, device types, and clinical use cases
- Application-specific design pathways (cardiac, neurovascular, peripheral, structural, EP, etc.)
- Catheter nomenclature and industry-standard terminology
- Fundamental design requirements (performance, safety, manufacturability, regulatory constraints)

Learning outcome

Participants gain a common technical language and conceptual framework that underpins all subsequent design, material, and process decisions throughout the workshop.

Chapter 2: Liners and Mandrels

The internal foundation of catheter performance.

Objective: Explain the role of liners and mandrels as the primary internal structural and functional elements of catheter systems.

Key topics covered

- Functional purpose of liners in catheter systems (lubricity, sealing, abrasion resistance, material compatibility)
- When and why liners are required versus liner-less constructions
- Device-specific drivers influencing liner and mandrel selection
- Common liner and mandrel materials and their mechanical properties
- Industry-preferred solutions and the technical reasons behind them
- Alternative liner and mandrel options and their trade-offs
- Leading PFAS free solutions and integration / new manufacturing pathways

Learning outcome

Participants understand how early internal component decisions fundamentally constrain or enable downstream reinforcement, lamination, and performance tuning.

Chapter 3: Reinforcement Technologies

The structural backbone of catheter performance.

Objective: Provide a deep technical understanding of reinforcement strategies and their dominant influence on catheter behaviour.

Key topics covered

- Detailed exploration of braiding, coiling, and laser-cut reinforcement patterns
- Methods, materials, and manufacturing techniques for each reinforcement type
- How reinforcement architecture controls torque, pushability, kink resistance, and flexibility profiles
- Adjustment strategies for tuning catheter performance variables
- Downstream impacts of reinforcement selection on packaging, handling, and device robustness

Learning outcome

Participants gain the ability to intentionally design and adjust catheter mechanical performance rather than relying on trial-and-error iteration.

Chapter 4: Polymer Layers, Heat Shrinks & Sterilisation

Creating the external interface and protective structure

Objective: Examine the outer polymer jacket as a critical interface between the device, anatomy, and clinical workflow. Explore the various heat shrink technologies used in manufacturing, processing or as final components. Understand the sterilisation pathways existing on the market and gain insights into the leading routes for environmental sterilisation.

Key topics covered

- Industry-standard and emerging polymers used for outer catheter jackets
- Polymer–polymer interactions, compatibility, and bonding considerations
- Lamination process options and process-variable control
- Heat shrink technologies for lamination
- Traditional and advanced heat-shrink technologies used in final devices
- Sterilisation pathways (EtO, gamma, e-beam, emerging paths)
- Material compatibility with sterilisation methods and resulting effects on catheter performance

Learning outcome

Participants understand how material selection and process choices at this stage directly affect device manufacturability, automation, performance, biocompatibility, regulatory viability, and clinical usability.

Day 2 – Design Integration & Practical Application

Chapters 5 & 6: Catheter Design & Manufacturing Strategies

Design and processing from concept to scalable production.

Objective: Demonstrate how catheter devices (outlined on pages 6-8) are designed and manufactured, alongside how they are adapted across device types, quantities, and manufacturing scales.

Key topics covered

- Analysis of 12 distinct catheter and sheath architectures
- Manufacturing pathways for low-volume prototyping through high-volume production
- 70+ post processing technologies and techniques
- Process selection based on complexity, tolerances, and cost

Synopsis of processes covered:

- Cutting – Guillotine, slice, roll, and automated cutting routes
- Hubs, valves, luers, and connectors
- Adhesives – Cyanoacetate, Epoxies, UV Adhesives, and combination adhesives (UV/CA, UV/Thermal)
- UV Adhesive curing methods
- Injection moulding and insert/overmoulding
- Flaring, flanging, nail heads, interlocking features
- Tipping
- PAD printing, Inkjet printing, and Laser marking
- Chemical and Plasma etching
- Marker bands, RO polymers, and radiopacity
- Mandrel removal processes. Manual, automated, stretching, and straightening
- Distal end shaping, internal shaping, and cassette shaping
- Hydrophilic coating
- Microfabrication (future of neuro technologies)
- Pull wire development (for articulating / steerable devices)
- Wire welding, Tig, Arc, Laser
- Catheter end bonding, split/butt weld bonding
- Handle design overview (high level direction of important features for devices)
- RX / Rapid exchange port design
- Punching, hole drilling, and laser drilling
- Skiving
- Balloon development, compliant, semi-compliant and non-compliant routes
- Necking and tapering
- EP electrode positioning and integration
- Cooling channel design, concentric vs non-concentric
- Sheathed catheter design (telescopic design, transferrable between stent and valve delivery)

Learning outcome

Participants gain practical insight into how design intent, process capability, and production scale must be aligned to achieve commercially viable devices.

Chapter 7: Prototyping & Hands-On Build

Translating theory into physical devices and tangible knowledge.

Objective: Reinforce theoretical learning through hands-on catheter construction. A key component to our Masterclass which helps to embody the teachings into applicable knowledge. Helping to elevate the learnings into practical knowledge.

Key activities

- Guided prototyping of a 4 section introducer / guiding sheath
- Application of liner, reinforcement (braid or coil), and lamination principles
- Slice, roll and guillotine cutting processes
- Termination and tipping
- Hub mounting and adhesives (smart hub NFC integration)
- Braid termination (if applicable)
- PFAS free solutions (if applicable)
- Real-time troubleshooting and performance evaluation
- Exposure to practical manufacturing constraints and techniques

Learning outcome

Participants gain a tangible prototyping experience, a deeper intuition for catheter construction, and the confidence to progress ideas from concept to functional device.

Chapter 8: Future of Medical Device Technologies

An outlook on the trends and technologies which are shaping future device design and production paths.

Objective: To examine the emerging technologies shaping the next generation of medical devices, including advanced materials, robotics, digital integration, smart sensing, minimally invasive platforms, AI-assisted systems — and to evaluate how these innovations will influence catheter design, manufacturing strategies, regulatory pathways, and clinical performance over the next decade.

Key activities

- Emerging materials, processes, and imaging technologies which are unlocking new capabilities
- Key supporting technologies which are enabling new and emerging catheter technologies
- Industry insights into where medical technology advancements are being made
- Beyond the Horizon of Medical Devices: A forward-looking insight into how medical devices are likely to evolve over the next 30+ years — and what that means for innovation, design, and patient care.

Learning outcome

Participants leave with a deep understanding of where technologies are emerging, the devices which will be developed over the coming decade and where to leverage expectations of supporting materials and processes to incorporate during their development.

Focus Products / Devices / Technologies

Our expertise and experience span a wide range of catheter technologies. We have developed or supported all the following devices in some capacity during our work. This masterclass provides the essential processing and design knowledge to develop each of the following devices.

Devices not listed can be assessed through shared architectural principles and cross-over catheter technologies.

1) **Vascular Catheter Technologies (Intravascular)**

A) Peripheral Vascular (PAD / PVD)

1. *Diagnostic angiography catheters*
2. *Guidewires*
3. *Introducer sheaths*
4. *Guiding sheaths*
5. *PTA balloon catheters*
6. *Drug-coated balloon (DCB) catheters*
7. *Stent delivery systems*
8. *Atherectomy catheters (directional / orbital / rotational / laser)*
9. *Thrombectomy systems (aspiration / mechanical)*
10. *Chronic total occlusion (CTO) crossing catheters*
11. *IVUS catheters*
12. *Peripheral embolisation catheters (microcatheters)*

B) Neurovascular

1. *Guide catheters*
2. *Intermediate / distal access catheters*
3. *Microcatheters*
4. *Neuro guidewires / microwires*
5. *Balloon angioplasty catheters*
6. *Stent delivery systems (intracranial / carotid)*
7. *Flow diverter delivery systems*
8. *Aspiration thrombectomy catheters*
9. *Stent retriever systems*
10. *Coil delivery systems*
11. *Liquid embolic delivery catheters*
12. *Neuro protection devices (filters, proximal occlusion)*

C) Interventional Cardiology (Coronary)

1. *Diagnostic coronary catheters*
 2. *Guiding catheters*
 3. *Guide extensions*
 4. *Coronary guidewires*
 5. *PTCA balloon catheters*
 6. *Drug-eluting stent (DES) delivery systems*
 7. *Cutting / scoring balloons*
 8. *Intravascular imaging catheters (IVUS, OCT)*
 9. *FFR / iFR pressure wire systems*
 10. *Rotational / orbital atherectomy systems*
 11. *Coronary thrombectomy*
 12. *Vascular Biopsy (directional atherectomy)*
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2) Structural Heart & Large Bore Access

1. Large-bore introducer sheaths
 2. Transseptal access systems (needles, sheaths, dilators)
 3. TAVR delivery systems
 4. Mitral repair delivery systems (e.g. clip delivery)
 5. Left atrial appendage closure delivery systems
 6. PFO/ASD closure delivery systems
 7. Paravalvular leak closure delivery systems
 8. Cerebral protection device delivery systems
 9. Vascular closure devices (percutaneous closure)
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3) Electrophysiology (EP) & Cardiac Ablation

1. Diagnostic EP catheters
 2. Mapping catheters (circular, basket, high-density)
 3. Ablation catheters
 4. RF ablation
 5. Cryoablation (balloon systems)
 6. Pulsed Field Ablation (PFA) catheters
 7. Steerable sheaths
 8. Transseptal sheaths and dilators
 9. Intracardiac echocardiography (ICE) catheters
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4) Venous Access & Infusion Catheters

1. Peripheral IV catheters
 2. Midline catheters
 3. PICC lines
 4. Central venous catheters (CVC)
 5. Tunnelled catheters
 6. Dialysis catheters
 7. Implantable port systems
 8. Catheter securement devices
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5) Urology Catheter Technologies

1. Foley catheters
 2. Intermittent catheters
 3. Suprapubic catheters
 4. Ureteral stents
 5. Nephrostomy catheters
 6. Stone retrieval devices (baskets/Aspiration)
 7. Ureteroscopes (scope devices)
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6) Implantable Catheter Technologies

1. Central Venous Access Devices (CVADs)
 2. Cerebrospinal Fluid (CSF) Shunt Systems
 3. Implantable Drug Delivery Systems
 4. Peritoneal & Fluid Drainage Catheters
 5. Cardiac Implantable Leads
 6. Gastrointestinal Implantable Tubes (PEG tubes)
 7. Long-Term Vascular Monitoring
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7) Gastroenterology / Endoscopy Devices

Flexible endoscopes + accessory delivery devices

1. Flexible scopes (gastroscope, colonoscope, duodenoscope)
2. ERCP cannulation catheters
3. Sphincterotomes
4. Guidewires
5. Balloon dilators
6. Stone extraction balloons/baskets
7. Stent delivery systems (biliary, pancreatic, GI)
8. EUS / EBUS Biopsy Needles (endoscopic ultrasound)
9. Injection needles
10. Haemostatic devices
11. Haemoclips
12. Coagulation probes
13. Hemospray delivery
14. Polypectomy snares
15. Biopsy forceps
16. Biopsy (core needle, FNA, VAB)
17. Endoscopic closure devices

8) Respiratory / Pulmonology Catheter & Scope Devices

1. Bronchoscopes (flexible)
2. Bronchial biopsy tools
3. Bronchoalveolar lavage (BAL) catheters
4. Endobronchial ultrasound (EBUS) scopes
5. Lung navigation catheters (EM navigation)
6. Airway stent delivery systems
7. Bronchial thermoplasty catheters
8. Ablation Devices (RF, PFA, microwave)

9) Interventional Radiology (IR) / Embolisation

1. Diagnostic angiography catheters
2. Microcatheters
3. Embolisation delivery catheters
4. Chemoembolisation delivery systems
5. Radioembolisation delivery systems
6. Drainage catheters (abscess, biliary, nephrostomy)
7. Biopsy devices (coaxial systems)

10) Oncology / Targeted Therapy Delivery

1. Transarterial delivery catheters
2. Intratumoral injection catheters
3. Implantable infusion systems
4. Catheter-based localised drug delivery devices

11) Women's Health / OB-GYN Catheter Devices

1. Hysteroscopes (scope category)
2. Embryo transfer catheters
3. IUI catheters
4. Uterine manipulators
5. Balloon tamponade devices (postpartum haemorrhage)

12) Paediatrics / Neonatal (cross-category)

1. Micro-lumen access catheters
2. Neonatal PICCs
3. Miniaturised guidewires and sheaths
4. Combination drug delivery devices