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# Highlights from the 67th Annual Meeting of the American Society for Artificial Internal Organs in Chicago, IL

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## Introduction

Dr. Willem J. Kolff founded the American Society for Artificial Internal Organs (ASAIO) in 1955. Each year experts in the fields of renal, pulmonary, pancreatic, cardiac, bioengineering, and orthopedic research congregate to discuss the latest developments in their respective fields. Throughout the conference's history, ASAIO has adapted to promote inquiry, ingenuity, and innovation. The congeniality partnered with the expertise of the conference's attendees has facilitated continuous progress since the conference's inception.

The 2022 ASAIO Annual Conference was held in Chicago, IL in an entirely in-person format, the first since the 65th conference in 2019. This year there were exhibits by Abbott (Austin, TX), ABIOMED, Inc. (Danvers, MA), Acelis Connected Health (Livermore, CA), ActiCare Health (Livermore, CA), Berlin Heart, Inc. (The Woodlands, TX), EvaHeart, Inc. (Houston, TX), Getinge (Sweden), Haemonetics Corp. (Braintree, MA), La Jolla Pharmaceutical (Waltham, MA), Medtronic Cardiac Surgery (Framingham MA), NxStage from Fresenius Medical Care (Lawrence, MA), Orthodynamics Company, Inc. (Noblesville, IN), Transonic Systems Inc. (Ithaca, NY), and Wolters Kluwer Health (Philadelphia, PA). Presentations, posters, and abstracts covered topics in the disciplines mentioned above as well as COVID for the second year in a row. All abstracts were accessible via the ASAIO App.

## Addresses

### President's Address – Innovation is Never Evidence Based

This year's address from Dr. Joseph Zwischenberger (Lexington, KY) centered around his teenage interests related to restoring antique automobiles, and its influence on his career in

medicine and artificial organ development. He detailed the foundational interconnectivity between physics and physiology and laid out the pivotal moments over 40 years that led to the evolutions of his innovations including the first double lumen catheter for extracorporeal membrane oxygenation (ECMO), a refined percutaneous double lumen catheter for ECMO that largely eliminated mixing of saturated and desaturated blood flows, heat exchangers, gas exchangers, and circulatory assist devices. From his career in research, he was able to impart on the attendees that, innovation does not necessarily require original ideas, but rather revisiting and interconnecting them.

**Keynote Address**

Bartley P. Griffith and Mohammad Mohiuddin made national and international news earlier in 2022 with the first successful implantation of a porcine heart into a human being. In his keynote address, Dr. Griffith discussed the challenges to reach the human donor transplant equivalence and the further challenges in xenotransplantation that remain. He pointed out the as-yet poorly understood cause of rapid heart dysfunction in the patient. The porcine cytomegalovirus seems to have played a destructive role, which, while it did not newly infect the recipient, may have injured the heart upon reactivation following immunosuppression. He also discussed the future of human xenotransplantation research, which includes strategies that might reduce immune-suppression burdens. Once safety evolves, he opined that over the next 20 years there could be on-demand hearts and kidneys transplants.

**History Committee - ASAIO, Reflections and Projections**

Robert Bartlett, of the ASAIO History Committee, presented “ASAIO, Reflections and Projections.” Among his reflections, Dr. Bartlett discussed the importance of the society since

its inception in supporting artificial organ development and implementation. In particular, he recognized the extensive contributions of Jean Kantrowitz, a major proponent of the archiving of the history of artificial organs, and Karen Burke, the former Executive Director/Officer of ASAIO for 52 years, to the foundation and establishment of the society. He further discussed the history committee's role in preserving the accounts of artificial organ milestones, noting two particular projects that centralize this information: Project Bionics (compiled by Shelley McKellar) and the 25 Landmark Papers Published by ASAIO.[1] Dr. Bartlett concluded his talk with topics he expects to see at future ASAIO conferences based on the field's current trajectory.

**ASAIO Hastings Lecture**

Stephen R. Topaz, a mechanical engineer involved in the early development of artificial hearts, had the honor of being the lecturer of this year's Hastings lecture. This recurrent lecture, which acknowledges the contributions of those who have given back to science, is named after Frank W. Hastings, a pioneer in the development of a total artificial heart.[2] Topaz is perhaps best known for his invention of the intra-aortic balloon pump (IABP), although as a tinkerer and inventor, his hands have worked on other medical devices such as artificial hearts and the fetal heart monitor. Mr. Topaz, like Dr. Zwischenberger, considers concepts and designs from mechanical and industrial engineering to be fundamentally the same as those needed in vivo. In his lecture, Mr. Topaz recalled his days working in the laboratory of Dr. Kolff where he, despite neither having a degree in neither medicine nor biology, worked to configure an artificial heart that could sustain life.

**Innovating Healthcare for the Next 100 Years**

To portend the future of today's convoluted healthcare system, Tomislav Mihaljevic, CEO and President of Cleveland Clinic, delivered his insight based on his varied experiences in healthcare as a cardiac surgeon and now an international healthcare leader. He described innovation as "central to the success" of Cleveland Clinic and the "lifeblood" of organizational growth. From his observations he claimed that no obstacles in healthcare are too great if healing is the focus. However, if we focus on immediate costs instead of innovating towards the delivery of overall benefits, there is nothing more that we can expect than substandard care worldwide. To drive healthcare innovation, he suggested applying solutions external to medicine related to data organization, service efficiency, and communication. To conclude, Dr. Mihaljevic acknowledged that to attain these goals, conflict of interest "should be managed, not avoided."

**Special Sessions**

**MCS/VAD University**

The conference opened with the sixth MCS/VAD University on June 8. Jamshid H. Karimov, Egemen Tuzun, Errol Bush, and Vakhtang Tchantchaleishvili chaired the course**.** Ventricular assist device (VAD) University offers an innovative update on the status of temporary and durable mechanical circulatory support (MCS), including, but not limited to, current indications, engineering aspects, device application, and management of complications.

The first session, titled "State of the Art of Mechanical Circulatory Support (MCS)," commenced with Claudius Mahr's (Seattle, WA) overview of percutaneous left ventricular assist devices (LVADs), followed by Keshava Rajagopal (Houston, TX) on the present and future of

durable right ventricular (RV) mechanical support. Subsequently, Georg Wieselthaler (San Francisco, CA) presented on biventricular assist devices, and Fracisco Arabia (Phoenix, AZ) presented on patient selection for total artificial hearts (TAHs). The first session concluded with an overview of MCS anti-thrombotic pharmacology by Marvin Slepian (Tucson, AZ).

The second session titled "Engineering Considerations" began with an overview of continuous-flow (CF) MCS devices by Kevin Bourque (Abbott). Sensor technologies for the realization of intelligent VADs was then discussed by Marianne Schmid Daners (ETH Zurich). Following her, Akif Ündar (University Park, PA) covered fundamentals of pulsatility assessment during acute and chronic MCS. The session continued with Kiyotaka Fukamachi's (Cleveland, OH) insight on the new device concepts related to MCS for HFpEF. This session ended with John Valdovinos (Northridge, CA) describing the evolution from targeted energy transfer to deep-tissue wireless energy transfer.

Starting the next session titled "Tips and Tricks," Brian Lima (Dallas, TX) presented the topic "Moving the Needle on LV Unloading." J. W. Awori Hayanga (Providence, RI) continued with a presentation titled "Cannulate, Extubate, Ambulate." Following this talk, Bryan Whitson (Columbus, OH) talked about acute MCS options for RV unloading and recovery. The session ended with Aly El Banayosy's (Oklahoma City, OK) presentation on ECMO for extracorporeal pulmonary resuscitation following a pulmonary embolus.

The penultimate session reviewed the transition to durable support and transplant. Hasan Garan (New York, NY) questioned the IABP's role in 2022. Navin Kapur (Boston, MA) followed with his thoughts on the extended use of Impella as a bridge to transplant. The session

ended with Maziar Khorsandi (Renton, WA) who presented the transitioning from a short-term MCS to a durable LVAD or transplant.

The last session for the MCS/VAD University, entitled “Management of Complications,” initiated with “The Unmasking of Right Ventricular Failure” presented by David Joyce (Milwaukee, WI). The issues of thrombotic complications, GI bleeding, aortic insufficiency, and LVAD infections were discussed by Hari Mallidi (Boston, MA), Himabindu Vidula (Rochester, NY), Jesus Eduardo Rame (Philadelphia, PA), and Andrew Rosenbaum (Rochester, MN), respectively.

**Pediatric Medical Device Day**

The pediatric medical device course was held at the same time as the MCS/VAD University, and was chaired by George Mychaliska, Farhan Zafar, Angela Lorts, and Lindsay May. This portion’s purpose was to inform and advocate for the plethora of pediatric medical devices.

Vikram Sood (Ann Arbor, MI) started the “MCS” session with MCS strategies in patients less than 15 kg. Neha Bansal (New York, NY) communicated her experiences with MCS resource utilization during the COVID pandemic. Next, Katrina Fields (Cincinnati, OH) covered lessons learned from pediatric MCS. Arash Salavitabar (Columbus, OH) talked about incorporating CardioMEMS into pediatric clinical practice. Matthew O’Connor (Philadelphia, PA) shared his observations of MCS from a review of databases and multicenter studies. Anna Joong (New York, NY) ended the session summarizing VAD support in patients with bi-directional Glenn physiology.

"Perfusion/Organ Care/Lung & Heart," was led off with nitric oxide (NO) surface anticoagulation by Orsolya Lautner-Csorba (Ann Arbor, MI). This was followed with ideas for mitigating ECMO-associated contact pathway activation by Joseph Palumbo (Cincinnati, OH). From there, Gabe Owens (Ann Arbor, MI) presented on ex-vivo heart perfusion, which segued into Jennifer Conway's (Pittsburgh, PA) presentation on ex-vivo organ perfusion for pediatric heart/lung transplantation. Seth Hollander (Palo Alto, CA) continued with a talk on VAD renal implications. This session ended with another talk by Neha Bansal delving into the scarce donor pool for pediatric solid organ transplantation.

The "Advances in extracorporeal support" session began with updates from Brian Gray (Indianapolis, IN) on the pediatric ECMO cannula. Emily Partridge (Philadelphia, PA) discussed the use of a pumpless arterial-venous (AV) ECMO in prematurity and congenital diaphragmatic hernia. Ronald Hirschi (Ann Arbor, MI) presented on the pediatric artificial lung, which was complemented by a presentation on the artificial placenta by George Mychaliska (Ann Arbor, MI).

To end the Pediatrics Medical Device Day, the final session centered on Implantable devices/Airway splints/Novel cardiac devices. Ben Hale (Ann Arbor, MI) outlined the future directions in cardiac devices. Jeffrey Zampi (Ann Arbor, MI) presented an update of new valves used in interventional cardiology and a new bioabsorbable ASD device. Richard Ohby (Ann Arbor, MI) followed by speaking on airway splinting. The session and day concluded with Gwenyth Fisher (Minneapolis, MN) providing her perspective on pediatric device innovation.

**MCS Bootcamp**

The conference finished with the MCS Bootcamp co-chaired by Heather Moody, Krista M. Marz, and Erin August. The course targets clinicians specializing in MCS and provides interactive training including firsthand case scenarios. Each of the four concurrent paths highlighted a particular device. Carrol Ballew, Tyson Stevens, and Miriam Ross spoke on the Medtronic HeartWare VAD (HVAD), while Elisa Richards and Lina Suplicki focused on the Abiomed Impella. Sam Edwards and Lisa Kukla discussed Abbott's HeartMate 3, and Nicole Graney and Amber Merritt featured the Centrimag.

**Corporate Lunch Talks**

Abbott held a panel discussion featuring their MCS engineers. Both Abiomed's Alen Gass and Scott Silvestry led a discussion on optimally introducing Impella, managing ECpella in the ICU, and how and when to wean ECMO. Simultaneously, Desiree Robson, Thomas Schlöglhofer, Erin Davis, and Sarah Schettle highlighted best practices specific to Medtronic HVAD patients.

**General Sessions**

**COVID**

For the second year in a row, COVID-related issues were a dedicated topic. Mary Maldarelli (Baltimore, MD) presented an increased prevalence in cannula-associated DVTs among COVID-19 patients on veno-venous (VV) ECMO. Then Viswajit Kandula (Chicago, IL) suggested that lung transplantation improved survival for COVID-19 patients on extended VV ECMO. Jeffrey Javidfar (Decatur, GA) presented predictors of respiratory failure for COVID patients. Vincenzo Cantaluppi (Italy) then demonstrated an increased incidence of acute kidney injury in COVID patients. Ankit Bharat (Chicago, IL) discussed the challenges of lung

transplantation in the COVID era. This was followed by a Pro/Con panel on early lung transplant in severe COVID patients, with Ankit Bharat pro-transplant and Bryan Whitson against.

In a second COVID session, Juan Munoz-Largacha (Birmingham, AL) led with increased post-tracheostomy bleeding in COVID patients requiring ECMO. This segued into Melina Shonio's (Philadelphia, PA) talk on the hemodynamic benefits of percutaneously inserted chest tubes for COVID patients on ECMO. Christina Creel-Bulos Shah (Atlanta, GA) shared a potential justification of prolonged VV-ECMO in highly selected COVID-associated-respiratory-distress-syndrome patients. Sarah Park (Milwaukee, WI) presented the correlation between bleeding complications and cannulation for patients with SARS-CoV-2 pneumonia on ECMO. The session wrapped up with talks by Jerrold Levy (Durham, NC) on the relationship between COVID-19, thrombosis, and bleeding, and another by Steven Keller (Boston, MA) on the advancement of critical care technologies resulting from the pandemic.

**Bioengineering**

The Bioengineering track was led off by Elyse Fleck (Ann Arbor, MI) sharing the world's first 3D printed microfluidic artificial lung. Navid Shaikh (Ann Arbor, MI) and his team assessed a control system that automatically adjusts $CO_2$ removal in artificial lungs. Rei Ukita (Nashville, TN) presented a proof-of-concept for long-term wearable support for patients with pulmonary hypertension and RV failure. Teryn Roberts (The Geneva Foundation) demonstrated a method (LiNORel) that reduces platelet activation. Moving on, Ian Berg (Birmingham, AL) presented a model system to investigate the effect of high pressure and flow characteristics on von Willebrand factor (vWF). Richard Figliola (Clemson, SC) presented a non-obstructive, long-term, single impeller Fontan pump that could serve as a cavopulmonary assist device. Martin Maw

(Austria) then proposed a control system with adaptability of patient hemodynamics. Following that, Marianne Schmid Daners (Switzerland) discussed a cannula add-on system that can independently measure flow rate waveforms. To finish the session, Chihiro Miyagi (Cleveland, OH) presented findings from 3D-printed infant CF-TAH implantations in a pediatric patient cohort.

The second session was led by a talk from Sailahari Ponnaluri (University Park, PA) evaluating the computational fluid dynamics simulations of mechanical support devices. Hedra Setiadi (Oklahoma City, OK) suggested an unusual relationship between blood trauma and leukocyte microparticles induced by microaxial support devices. Elyse Fleck presented a newly designed resin that facilitates easier microfluidic 3D printing. Yasuhiro Fujii (Japan) then compared the performance of a diamond-like carbon-coated expanded polytetrafluoroethylene (ePTFE) vascular graft with a normal ePTFE. The session culminated with Marvin Slepian delivering an overview of hemocompatibility in 2022, followed by Palaniappan Sethu (Birmingham, AL) discussing the effects of pulsatility on vWF degradation.

"Bio- and Hemocompatibility" started with Max Skibber (Houston, TX) and his team's mechanotransductive approach to enhancing the immunomodulatory potential of mesenchymal stromal cells. Yeahwa Hong (Pittsburgh, PA) talked about the hemocompatibility of a novel pulmonary assist system using a modified HeartAssist 5 VAD or the Abbott Pedimag as the pump. Elyse Fleck then continued her earlier presentation by showing a reduced formation of blood clots on the 3D resin following the inclusion of hydrophilic molecules. Rodrigo Mendez Roiano (Ithaca, NY) argued that fibrin formation must be included in simulations of thrombosis in blood oxygenators. Christopher Sheils (Abiomed) presented a case

study of the usability improvements with pairing the Impella 5.5 with the SmartAssist. Rikki Kaufman (West Haven, CT) discussed his team's study to understand liposome synthesis and its applications in anti-platelet therapy. The third session ended with a discussion by Zhongjun Wu (College Park, MD) on platelet-related issues with MCS, and another by Jutta Arens (Netherlands) on the current situation of hemocompatibility with artificial lungs.

Novel technologies in bioengineering commenced with Joseph Zwischenberger presenting promising findings of Hyperthermic Extracorporeal Applied Tumor Therapy (HEATT®) as a safe and effective cancer treatment. Taliah Gorman (Tucson, AZ) talked about a microfluidic system for measuring platelet mechanical properties. Viswajith Siruvallur Vasudevan (Ithaca, NY) shared an algorithm that improves ventricular function in pediatric patients with a CF-LVAD. Jan Simoni (Texas HemoBioTherapeutics & BioInnovation Center) presented a new generation of blood substitute. The session ended with Sonya Bhavsar (Abiomed) and Kevin Bourque (Abbott) each sharing their outlook for MCS.

The last session of the Bioengineering track, focused on devices. Chihiro Miyagi gave two presentations, one evaluating the left atrial assist device (LAAD) and the other on the pediatric CFTAH. Michelle Mendiola Pla (Durham, NC) then communicated results of the NuPulse IABP. William Stoddard (Rochester, NY) presented on the DragonHeart. Jeremy Nezaria (Abiomed) followed up with clinical outcomes from pairing the Impella 5.5 with SmartAssist. Then, Jasmine Martinez (Melbourne, FL) delivered her team's analysis of the EVAHEART2. Orsolya Lautner-Csorba continued with a talk on an S-nitrosothiol type NO donor molecule. Thomas Schlöglhofer (Austria) showed reliable performance of the Confirm Rx implantable

cardiac monitor. Barry Kuban (Cleveland, OH) ended the session with his team's refinement of the LAAD.

**Cardiac R&D**

The first Cardiac Research and Development session led off with Nandan Mondal (Houston, TX) showing that alterations in oxidative phosphorylation be predictive of stroke after CF-LVAD implantation. Anjana Jayaraman (Ithaca, NY) presented hemocompatibility of a titanium alloy. Kaitlyn Ammann presented a sodium bicarbonate purge solution used with Impella. Hendra Setiadi who discussed plasma oncostatin, followed by M. Yana Roka-Moiia (Tucson, AZ) gave two presentations on platelets, showing that shear causes redistribution of adhesion receptors and desialylation. Jose Flores (South Gate, CA) discussed the first entirely catheter-deliverable wirelessly powered blood pump system. Anna Peeler (Baltimore, MD) presented palliative care's role in treating veno-arterial (VA-) and VV-ECMO patients.

The next session, titled "New Cardiac Research & Development," kicked off with Konstantinos Magkoutas (Switzerland) presenting benefits of real-time estimation of remaining cardiac contractility. Farhad Nezami (Boston, MA) presented a computational model simulation demonstrating VA-ECMO failure to deliver oxygenated blood to coronary arteries. Shweta Karnik (Atlanta, GA) exhibited the effects of twisted impeller blades on centrifugal LVAD performance. To continue, Duha Ilyas (United Kingdom) discussed improvements to Microneedle insertion. Kirsten Landsgaard (College Station, TX) talked about the impairment of angiogenesis by vWF degradation. Rene Aleman (Weston, FL) contended that fluorescent angiography could be used effectively in non-cardiac surgeries, even in patients on ECMO. The next talk, from Alexis Shafii (Houston, TX), was on the intra-cardiac endograft as a platform for

CF-RVAD usage. Karen May-Newman (San Diego, CA) presented hemodynamic interactions between a native heart and the HeartMate 3 LVAD. Brianna Spencer (Ann Arbor, MI) closed out the session with how high dose NO during cardiopulmonary bypass mitigated the overall inflammatory response.

The third session commenced with Matthew Johnson (Ann Arbor, MI) illustrating that ex-vivo normothermic perfusion following resuscitation allowed for the successful transplantation of porcine hearts. Trevor Snyder (CorWave) presented results from testing of the pulsatile CorWave membrane LVAD. Marvin Slepian presented on a novel polymeric transcatheter aortic valve as an alternative to tissue-based valves. Fanette Chassagne (France) then shared an investigation of the timing of LVAD pulsatility events on intraventricular hemodynamics. Navin Kapur and his team defined baseline and maximum stages of cardiogenic shock severity. Thomas Schlöglhofer and Venkat Keshav Chivukula (Melbourne, FL) presented performance assessment tools for the HeartMate 3 and EXCOR, respectively. Wenxuan He (Ithaca, NY) demonstrated simulated fluid dynamics accompaning surface modification. Heinrich Schima (Austria) then presented flow effects of the HeartMate 3's artificial pulse. Marissa Miramontes (Seattle, WA) continued with a talk on hypertension's effect on cerebral perfusion in VAD patients. Moving forward, Hideyuki Horie (Japan) shared battery alternatives for wireless LVAD devices. Wrapping up the session, Jerome Riebman (Aziyo Biologics) presented on an acellular biologic extracellular matrix envelope.

**Cardiac Clinical**

To launch the cardiac topics of clinical concern, Andrew Cheng and then Stacy Tsai (Los Angeles, CA, both) each individually presented talks related to the Impella 5.0 and 5.5. Zahidee

Rodriguez (Atlanta, GA) then discussed machine-learning algorithms to differentiate audio features in systemic to pulmonary shunts. This neatly transitioned into a talk by Song Li (Seattle, WA) titled “Machine Learning in Advanced Heart Failure.” The first session finished with Manreet Kanwar’s pre-recording (Pittsburgh, PA) titled “Contemporary Management of Cardiogenic Shock: Focus on Mechanical Circulatory Support.”

Mustafa Ahmed (Gainesville, FL) pointed out the current under-utilization of LVAD in minorities. Jasmine Martinez presented her team’s work on optimizing HeartMate 3 speed. Mustafa Ahmed presented a case study of targeted treatment guided by a TEG® platelet mapping™ assay. Harrison Smith (Spokane, WA) shared a multi-faceted approach to reduce LVAD driveline infection. Claudio Bravo (Seattle, WA) presented a cohort study of LVAD patients with outflow graft stenoses. Laura Coyle (Oak Lawn, IL) continued with device exchanges from the HVAD or the HeartMate II to the HeartMate 3. To close out the session, Zhaozhi Li (Chicago, IL) presented on the impact of insurance type on clinic outcomes after LVAD implantation.

Jacqueline Soegaard Ballester (Philadelphia, PA) evaluated the Surgery Department at the University of Pennsylvania’s imperfect adherence to institutional guidelines for extracorporeal cardiopulmonary resuscitation (ECPR). Wyatt Klass (Pittsburgh, PA) presented a new protocol aimed at reducing incidence of Impella 5.5 dysfunction. Benjamin Shou (Baltimore, MD) presented a study finding that decreased pulsatility in VA-ECMO was associated with acute brain injuries. Abhiraj Saxena (Philadelphia, PA) presented a systematic review and meta-analysis regarding the utilization and outcomes of venoarterial-venous (VAV) ECMO. Following up, Clauden Louis (Rochester, NY) shared sex differences in mortality with VA-ECMO as a bridge to definitive management. Sinal Patel (Weston, FL) reviewed the clinical

outcomes of the MitraClip in acute decompensated heart failure. Siddharth Pahwa (Louisville, KY) presented that persistent renal dysfunction in patients with temporary MCS corresponds with poor early outcomes after heart transplant. Zhaozhi Li presented on the association between household median income and the clinical outcomes following LVAD implantation. Adam Paine (Boston, MA) presented data in support of endovascular axial flow LVADs as a bridge to transplantation. Culminating the cardiac clinical sessions were two panels. The first titled "Peripheral Versus Central Approaches for Acute MCS" was moderated by Vakhtang Tchantchaleishvili and had Biswajit Kar (Houston, TX) and Chuck Hoopes (Birmingham, AL) as panelists. The second titled "What is the Best Approach for Durable LVAD Implantation: Minimally Invasive, Off-Pump, Conventional?" was moderated by Scott Silvestry, and had Chris Salerno (Chicago, IL), Pramod Bonde (New Haven, CT), and Keshava Rajagopal as panelists.

**Pediatrics**

The first session started with James Antaki (Ithaca, NY) presenting on the PediaFlow™. Ares Menon (Berlin Heart GmbH) presented a novel cannula for sub-pulmonary MCS. Teimour Nasirov (Palo Alto, CA) reflected on twenty years of using pediatric VADs. David Blauvelt (San Francisco, CA) continued with a discussion of an artificial placenta oxygenator. David Bearl (Nashville, TN) presented on nutritional outcomes in pediatric paracorporeal VAD recipients, followed by Rugveda Thanneeru (Pittsburgh, PA) who shared a virtual anatomic fit study on the PediaFlow™. Seth Hollander (Palo Alto, CA) discussed an end-of-life experience of pediatric VAD patients.

David Peng (Ann Arbor, MI) presented on wearable devices in pediatric heart failure. Rachel Vanderlaan (New York, NY) conferred nuances of ECMO support for congenital heart

disease patients. Farhan Zafar (Cincinnati, OH) then gave ACTION study updates. Tiffany Hunter (Carbondale, IL) assessed the quality of life for pediatric VAD recipients. Shweta Karnik (Houston, TX) evaluated preload and afterload sensitivities of pediatric LVAD prototypes. Giselle Ventura (Cambridge, MA) investigated a growth adaptive pediatric heart valve. Kristen Nelson McMillan (Valparaiso, IN) ended the session on an anticoagulation stewardship program for pediatric ECMO patients.

The third session started with Priya Bhaskar (Dallas, TX) explaining the association between hypothermia and neurological outcomes in post-ECPR pediatric patients. Matt Wisniewski (Spring, TX) shared a case series of MCS for multisystem inflammatory syndrome in children (MIS-C). Manan Desai (Arlington, VA) demonstrated a neoatrium-continuous flow pump construct**.** Then Michelle Ploutz (Salt Lake City, UT) presented on the evolution of pediatric VAD care. Grant Rowlands (Ithaca, NY) evaluated vWF degradation in the PediaFlow™. To finish the third session, Merritt Tuttle (Milwaukee, WI) showed data suggesting Argatroban's support in VAD-supported pediatric patients.

Eric Griffiths (Salt Lake City, UT) kickstarted last session with VAD support approaches for Stage I and II infants. Danielle Burstein (Philadelphia, PA) presented the cost-effectiveness of using bivalirudin instead of heparin for pediatric VAD support. Danial Zimpfer presented the challenges that accompany VAD support for congenital heart disease. Li Li (Lexington, KY) then shared a 96-hour survival on a percutaneous cavopulmonary assist. Mansur Zhussupbekov (Ithaca, NY) continued with an automated shape optimization of PediaFlow™ stator blades. To finish the track, Katelin Omecinski (Pittsburgh, PA) presented a hollow fiber membrane based artificial placenta.

**Pulmonary**

Alberto Goizueta (Houston, TX) started the first of two pulmonary sessions discussing percutaneous tracheostomies in MCS patients. Lucian Durham (Milwaukee, WI) described a novel method for percutaneous ECMO cannula exchange. This was followed by a microfluidic blood oxygenation device presentation by Brett Isenberg (Cambridge, MA). Hussain AlShimali (Boston, MA) then discussed the development of atrial arrhythmias after VV-ECMO. The session wrapped up with Steven Keller talking of the advanced diagnostics and automated control of ECMO support.

Hussain AlShimali discussed the outcomes of patients with acute respiratory failure started on ECMO. Ana Costa from (Netherlands) presented the effect of fiber orientation on kidney-supported artificial lung gas exchange. Nayeem Imtiaz (Rochester, NY) continued with describing the hemocompatibility and oxygen transport properties of a miniature microfluidic ECMO device. Zhongjun Wuthen compared contributions of shear stress and device surface features to blood cell damage within ECMO devices.

**Renal**

The first session of the renal track, "Vascular Access – Unmet Needs, Science, and New Devices," highlighted arteriovenous fistulas (AVFs). Timmy Lee (Birmingham, AL) led the session with the clinical needs and biology of AVFs, which was followed by AVF vascular biomechanics presented by Yan-Ting Shiu (Salt Lake City, UT). Geoff Tansley (Artio Medical) discussed Amplifi, while Saravanan Bala (Becton, Dickinson and Company) addressed WavelinQ and Ellipsys, each one an adjunct to AVF surgery.

The second renal subtopic covered renal cell therapy and the bioartificial kidney. Joseph Stavas (Winston-Salem, NC) presented the regeneration of renal cells, and was followed by David Humes (Ann Arbor, MI) with his talk "Renal Cell Therapy: From bioartificial kidney to COVID." Fokko Wieringa (Netherlands) also spoke about the bioartificial kidney. Stephen Ash (HemoCleanse) rounded out the day with an oral mixture capable of removing uremic toxins.

The concluding section leaned towards renal support devices. Vincenzo Cantaluppi gave the first presentation on extracellular vesicles. Ji-Min Jang (Jacksonville, FL) then discussed a case series of CKD patients on the Impella 5.5. Toshiya Okahisa (Japan) presented a Cell-free and Concentrated Ascites Reinfusion Therapy device. The audience heard from Vincenzo Cantaluppi on polymethylmethacrylate membranes in hemodialysis. This was followed by the talk "Managing Catheter Infection, Thrombosis, and Fibrin Sheath" by Stephen Ash. The session concluded with Andana Niyyar's (Atlanta, GA) presentation on ultrasound implementation in vascular access management.

**Nursing/VAD Coordinator**

The VAD/Nursing Coordinator track focused on the management and care of VAD patients. Adrianne Edlund (Rochester, NY) demonstrated a trial run encouraging early mobility of LVAD patients, while a team including presenter Lisa Wiederspan (Seattle, WA) developed a VAD education plan. Thomas Schlöglhofer presented effects of inflow cannula position on the risk of stroke in HeartMate 3 patients. This was followed by an exploration of VAD patient caregivers' roles in a patient's home by Martha Saylor (Baltimore, MD). Sarah Schroeder (Bryan Heart) discussed the necessity of integrating palliative care into an MCS program. The day's session ended with a debate on the necessity of center strategies in caregiver requirements,

with Jennifer Nowaczyk (San Diego, CA) defending the pro/national perspective, and Janelle McLean (Australia) arguing from a con/international perspective.

Jonathan Haft (Ann Arbor, MI) discussed modern device exchange. Tonya Elliot (Joint Commission) and Erin Davis (Det Norske Veritas Healthcare) then pointed out the differences in VAD certification between the two organizations. To end, a debate transpired between Sunil Pauwaa (pro) (Oak Lawn, IL) and Brian Houston (con) (Charleston, SC) on the use of emergent therapies when treating patients with guideline-directed medical therapies.

The final session began with Eddie Betterton (Tucson, AZ) discussing short-term MCS, followed by future directions of the TAH by Francisco Arabia. The session closed with Janine Rumora (Rochester, NY) talking about treatment implications associated with VADs.

**Awards**

**Abstracts**

The top abstract from each track (listed below) presented in a special session. In addition, awards were given to the fifty top scoring abstracts across all tracks.

- *Top Cardiac Clinical:* Comprehensive Machine Learning Analysis of Pre-implantation Risk Factors for Right Heart Failure after LVAD Implantation (Arjun Bahl, Seattle, WA).
- *Top Bio:* Identification of Biomarkers Sensitive to Pulsatile and Continuous Flow for Identification of Promising Continuous Flow VAD Modulation Protocols to Mitigate Non-Surgical Bleeding Events (Khanh Nguyen, Birmingham, AL)
- *Top Peds:* Taking ACTION: A Contemporary Prognostic Tool for Pediatric VAD Morality (Katerina Boucek, Cincinnati, OH).

- *Top Nursing*: Self-Measured Doppler Blood Pressure Readings in Continuous-Flow LVAD Patients are Reliable (Desiree Robson, Australia).
- *Top Cardiac R/D*: Combining VA-ECMO and Impella (EC-Pella) Before Reperfusion Mitigates Left Ventricular Loading and Injury Due to VA-ECMO in Acute Myocardial Infarction (Kay Everett, Boston, MA).
- *Top Pulmonology:* Real-World Use of Extracorporeal CO2 Removal (ECCO2R) to Correct Respiratory Acidosis: Analysis of the Hemolung Registry (Alexandra May, Pittsburgh, PA).
- *Top Renal:* A Dialysate-Free Portable Artificial Kidney Device (Jamie Hestekin, Fayetteville, AR).
- *Top Covid:* Platelet Function at the Intersection of the COVID-19 "Cytokine Storm" and Mechanical Circulatory Support (Kaitlyn Ammann, Tucson, AZ).

**Kolff Award**

The Kolff Award, recognizing the meeting's top abstract, went to Arjun Bahl. The first runner-up went to Khanh Nguyen, and the second runner up went to Alexandra May.

**ASAIO Y Nose International Fellowship**

This year's ASAIO Y Nose International Fellowship (funded by the The Yukihiko Nose Fellowship Foundation) recipient was Trevor Snyder for his talk "In vitro and In vivo Testing of the Pulsatile CorWave Membrane LVAD."

**ASAIOfyi—For Young Innovators Fellowships**

Two ASAIO for young investigators (ASAIOfyi) abstract fellowships, sponsored by the Paul S. Malchesky Fellowship Fund, were given, one to Claudio Bravo for "Outflow Graft

Stenosis in LVAD Patients A Cohort Study" and to Li Li for "Percutaneous Cavopulmonary Assist: From Design to 96 Hour Survival in Lethal Cavopulmonary Failure Sheep."

**ASAIO VAD Coordinator Leadership Award**

Barbara Elias was selected for the VAD Coordinator Leadership award for her commitment to the coordination of the VAD program at the Texas Children's Hospital.

**Posters**

Ninety-nine posters were on display throughout the conference. Of these, twenty-four posters were authored by ASAIOfyi members and eligible for the 2022 ASAIOfyi Poster Award. After an open vote by conference attendees, the award was given to Rene Aleman, "Veno-Arterial ECMO decannulation with percutaneous femoral arterial closure technique."

**Medical Device Entrepreneur's Forum**

Moderated by H. David Humes, Edward Berger (Larchmont Strategic Advisors), and Kurt Dasse (VADovations, Inspired Therapeutics, and Vero Biotech), this session provided innovators the opportunity to put forward their medical ideas to ASAIO attendees. First place was awarded to Christopher Pino (Ann Arbor, MI) for his selective cytopheretic device. In second place was Daniel Bowers (IVIVA medical), who presented an innovative approach to building biomimetic organ grafts. Coming in third place was Ronald Woods (OperVu, Inc.) for a conveyor belt enabling automated surgical counts.

**ASAIOfyi Programing**

**Student Design Competition**

Session co-chairs Egemen Tuzun and Claudius Mahr, as well as ASAIOfyi leadership team members Alice Sweedo and Anne-Marie Ginn-Hedman, moderated the event. First place was awarded to Preston Peak's (College Station, TX) project "A Mock Circulatory Loop Controlled Using a Personalized Elastance Function." Second place went to Christopher Hummel (Columbus, OH) and his team for a "Novel Tunneled Central Venous Catheter Removal Device." Third place was awarded to Rachel Hilner (Melbourne, FL) and her team for their pediatric heart assist device monitor.

**Meet the Pioneers**

Kurt Dasse (Cocoa, FL), H. David Humes, and Rhona Shanker (Gaithersburg, MD) divulged their career paths from aspiring researchers to pioneers in their respective fields, with each sharing how ASAIO impacted their success. The ASAIOfyi member-exclusive event led into a networking session to kick off the re-instituted ASAIOfyi mentorship program.

**Conclusion**

Considering the seemingly persistent turbulence in medicine over the last two years, it is a testament to ASAIO that this year there was a completely in-person conference with 551 attendees in the heart of Chicago. The amassing of experts in fields striving for scientific progress in all things related to artificial organs has created a fertile ground for the next frontier of scientific innovation.

**References**


1. Bartlett RH. Project Bionics. *ASAIO J*. 2001;47(1):1. https://mars.gmu.edu/bitstream/handle/1920/2031/index.htm

2. Holman WL. Innovation in Medical Devices—Lessons from the Past, Planning for the Future: Hastings Lecture 2019. *ASAIO J*. 2019;65(8): e82. doi:10.1097/MAT.0000000000001081