APRIL 21-25, 2022 | PEDIATRIC ACADEMIC SOCIETIES ANNUAL MEETING | DENVER, CO

NATIONAL PEDIATRICIAN-SCIENTIST COLLABORATIVE WORKGROUP

NPSCW
NATIONAL PEDIATRICIAN-SCIENTIST
COLLABORATIVE WORKGROUP

PAS
2022

National Pediatrician-Scientist Collaborative Workgroup

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Debra Boyer, MD, Chief Medical Education Officer and DIO, Pediatric Pulmonologist, Nationwide Children's Hospital, Ohio State College of Medicine

Bobbi Byrne, MD, Vice-Chair of Education, Professor of Clinical Pediatrics, Indiana University School of Medicine, Riley Hospital for Children

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David Olson, MD, PhD, Physician-Scientist Training Program Co-Director, University of Michigan

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Suong Nguyen, MD, PhD, Fellow Trainee, Infectious Disease, St. Louis Children's Hospital, Washington University

Weston Powell, MD, PhD, Fellow Trainee, Pediatric Pulmonary and Sleep Medicine Fellow, University of Washington and Seattle Children's Hospital

Danielle Callaway, MD, PhD, Fellow Trainee, Neonatology, Children's Hospital of Philadelphia, University of Pennsylvania

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NPSCW
NATIONAL PEDIATRICIAN-SCIENTIST COLLABORATIVE WORKGROUP

Who We Are

The National Pediatrician-Scientist Collaborative Workgroup represents a diverse group of medical educators, physician-scientists, pediatric chairpersons, program directors, and others. We focus on identifying, creating, assessing, and expanding best practices for training that supports the clinical and scientific development of pediatric physician-scientists during residency.

Mission

Foster the development of residency training models that will promote sustainability and success for pediatrician-scientist development and create new approaches to strengthen the pipeline to advance improvement and innovation in global child health.

Vision

Develop metrics to inform trainees and programs on approaches to training pathway selection, incorporate sustainable models for recruitment and support of pediatrician-scientist trainees from underrepresented backgrounds,and identify and disseminate best practices for training pediatrician-scientists in residency.

Strategic Focus

- **Strategies & Solutions to Institutional Barriers**
  - Physician-Scientist Leadership Perspectives-PAS 2019
    - Burns, et al. Fixing the leaky pipeline: identifying solutions for improving pediatrician-scientist training during pediatric residency. **Pediatric Research**, 2020.

  - Program Directors Perspectives-APPD 2019
    - Burns, et al. Physician-Scientist Training and Programming in Pediatric Residency Programs: A National Survey. **Journal of Pediatrics**, 2021.

- **Trainee Support**
  - Forster et al. Perspectives from the Society for Pediatric Research: Advice on Sustaining Science and Mentoring During COVID-19. **Pediatric Research**, 2021.

- **National Assessment of Physician-Scientist Training During Residency**
  - Audrea M. Burns, Daniel J. Moore, Catherine Forster, Weston Powell, Satid Thammasitboon, Margaret Hostetter, Pnina Weiss, Mark Ward, Rebecca Blankenburg, Melvin Heyman, Tara Wenger, Caroline Rassbach, Heather McPhillips, Anthony French, Michael Hogarty, Suong Nguyen, Bobbi Byrne, Donald Williams Parsons, Fernando Gonzalez, Andrew Nowalk, Jacqueline Ho, Katie Barrett, Shelley Kumar, Jordan S. Orange, Kate Ackerman. A Nationwide Assessment of the Requisites Needs for Pediatric Physician-Scientist Training as Reported by Residency Program Directors. **J Pediatrics**. July 2021. PMID: 34280401.

Collaborative Partnerships

Our goal is to partner broadly across pediatric societies to support best practices for pediatric physician-scientists during residency and fellowship training. Current partnerships include:

- Association of Medical School Pediatric Department Chairs (AMSPDC) Workforce Summit
- AAMC Training Opportunities for Physician-Scientists (TOPS) Committee
- Council of Pediatric Subspecialists (CoPS) Physician-Scientist Action Team
- American Board of Pediatrics (ABP) Physician-Scientists Working Group

Friday, April 22 – Monday, April 25
Physician-Scientist Meeting ThinkPOD

Friday, April 22, 1:00 pm - 2:30 pm
COLLABORATIVE INTERACTIVE SESSION
Forging Ahead: Identifying the Futures of Pediatric Physician-Scientists
Room 301-303

Sunday, April 24, 2:30 pm - 3:30 pm
NETWORKING
The Landscape of Physician-Scientist Training Programs: Educational Showcase and Networking
Room 201-203

Monday, April 25, 2:40 pm - 3:30 pm
SCHOLARLY SESSION
Mapping Strategies to Support Future Pediatric Physician-Scientists
Room 401-402

Table of Contents

SESSION CHAIR

AUDREA BURNS, PhD

Associate Program Director, Pediatrician-Scientist Program
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SESSION 1: CO-CHAIRS

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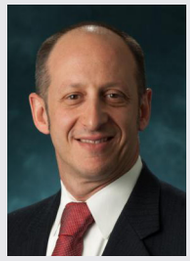

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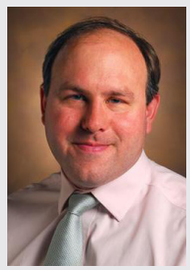

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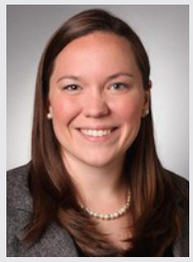

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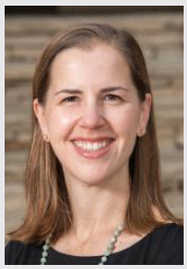

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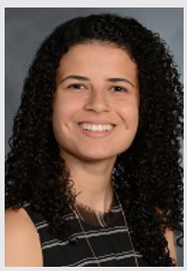

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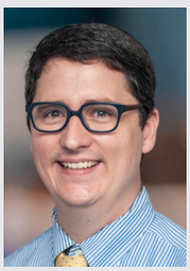

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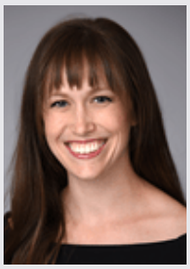

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Welcome to the first PAS LAB

dedicated to the future of Pediatric Physician-Scientists!

We are pleased that you are joining the National Pediatrician-Scientist Collaborative Workgroup (NPSCW) PAS LAB either as an expert panelist, a table chair, a moderator, or as a participant. This booklet contains important information that will enhance your participatory experience through a series of sessions.

We are all familiar with the extensive efforts to fix the leaky pipeline of pediatric physician-scientists, and many of us have invested in various ways to support young investigators who are committed to advancing research that improves child health. Despite decades of incessant efforts, a robust recovery and growth of child-health investigators has yet to be realized. Although many problems and issues have been identified, solutions to intercalated and complex challenges have remained elusive.

The overarching goal for this PAS LAB is to take a **forward view** that enables long-term solutions and strategies for action. This discourse will require a shift from being merely analytical to being creative and innovative – allowing our intuition, compassion, empathy and insight to guide us. To this end, we are employing Strategic Foresight to engage us in "thinking deeply about complex issues, imagining new possibilities, connecting signals into larger patterns, connecting the past with the present and the future, and making better choices today" (Marina Gorbis, Educause 2019). By detaching ourselves from our current struggles and obstacles and instead asking through internal reflection "How will the pediatric physician-scientist respond to these visionary futures," we hope to elicit new responses and insights that will give us new ground to develop physician-scientist training and careers. In brief, we are trying to come together to envision what it will mean to be a pediatric physician-scientist 10 years from now including the skills, tools and mindsets that will be needed for future success. Similar to parallel national efforts of strategic foresight to reimagine future competencies needed for pediatrics by the Association of American Medical Colleges (AAMC) and future job roles of Graduate Medical Educators by the Accreditation for Graduate Medical Education (ACGME) we will not be completely correct in all we consider, but we hope that this process will make us better today and importantly, better prepared for tomorrow.

This experience will kick off with our first session on **Friday, April 22**, from 1:00 pm – 2:30 pm where we will introduce the Strategic Foresight framework. An expert panel will discuss the trends and driving forces that are shaping this future, and everyone will participate in roundtable discussions to generate INSIGHTS, implications of the plausible futures that will shape the roles of the pediatric physician-scientist.

An extension of the discussion will continue with a networking session on **Sunday, April 24**, from 2:30 pm – 3:30 pm where programs will share challenges and innovations and facilitate interactive discussion on how we see ourselves building toward the future. As we continue to understand our strengths and current challenges we can allow for ongoing reflection using Strategic Foresight to prepare for future needs of the pediatric physician-scientist workforce.

Throughout the conference, you are invited to engage with our innovative ThinkPOD for pediatric physician-scientists. ThinkPOD serves as a physical space to engage with colleagues interested in contributing to the discourse about the future of the pediatric physician-scientist. Furthermore, you can also engage with us virtually or by following and contributing to the conversation on Twitter (#PASPhysSci).

We will conclude this series on **Monday, April 25**, from 2:30 pm – 3:30 pm with a short presentation of the key themes that were derived from our multi-day interactions. We will invite participants to begin the work of translating these insights into strategic planning to help make the future a reality.

Thank you for helping us shape the future of the pediatric physician-scientists.

PAS LAB Multi Sessions Goals

The development of a robust pediatric physician-scientist workforce remains a national challenge and has become critical in pediatrics. The number of highly trained pediatricians who are equipped to generate the next breakthroughs for children has stagnated or decreased despite an ever-present need to advance child health. The National Pediatrician-Scientist Collaborative Workgroup (NPSCW) represents a network of leaders and trainees from many pediatric programs nationwide. The NPSCW aims to address challenges during a critical window of the pediatric physician-scientist development, residency, and fellowship training. Combining findings from recent efforts and ongoing work from numerous initiatives, we have identified key areas for the next critical step. We propose to explore, investigate, and develop sustaining training models for future pediatric physician-scientists by engaging the pediatric academic communities through a PAS Lab, a series of collaborative sessions at the PAS Meeting 2022.

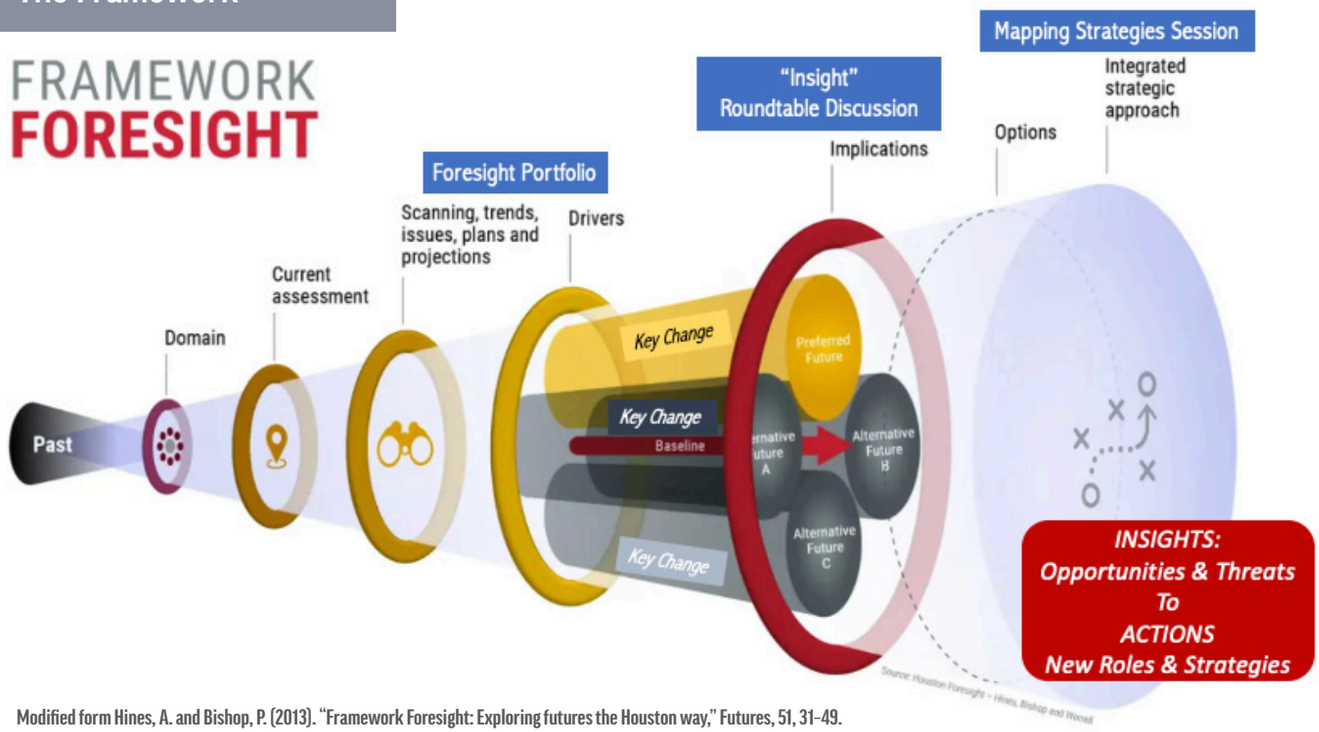
Training programs have indicated substantial needs to support development of innovative curricula that address physician-scientist development, create peer communities that foster meaningful engagement with scientific communities, and developing high-quality mentoring programs that address the specific needs of physician-scientist trainees. Although these were common themes across programs, the perspectives of programs on these issues varied across program size and related available resources. Through a broad representation of trainees, graduate medical education leaders, successful pediatric physician-scientists, and pediatric department leaders from diverse geographical regions and institutional makeups, the NPSCW uniquely positions itself to ally with key pediatric stakeholders dedicated to science and education (i.e., SPR, AMSPDC, APPD, APS, APA, CoPS, ABP, ACGME, COMSEP, NIH, AAP, BWF) to envision new insights, create shared models, and develop programs to achieve common goals.

The PAS Lab program serves as a mechanism to facilitate strategic exchanges amongst key stakeholders and our academic pediatric community. This PAS Lab will crystallize key questions around physician-scientist education and develop epistemic foundations for future studies and initiatives to address the future needs and opportunities for pediatric physician scientists.

Key goals of the PAS Lab will include the following divided into three sessions:

1. **Collaborative Interactive Session (Friday, April 22)** – The foresight framework will be used to invoke a vision for future pediatric physician-scientists and their training to understand future roles, identify needed training skills, explore the role of mentors, program directors, and leadership.
2. **Networking (Sunday, April 24)** – Maximizing diversity and inclusion to promote community engagement and networking; to create a shared understanding of efforts and barriers to training pediatric physician-scientist ThinkPOD.
3. **Scholarly Session (Monday, April 25)** – Formulating strategies to address challenges and barriers through meaningful engagement with stakeholders throughout the meeting
4. **ThinkPOD (Friday, April 22 – Monday, April 25)** – The ThinkPOD is both a physical and virtual gathering space. Come join us in the designated physical location at PAS to discuss ideas about physician-scientist development. If you aren't present physically, follow the online conversations at #PASPhysSci.

The Framework



Modified form Hines, A. and Bishop, P. (2013). "Framework Foresight: Exploring futures the Houston way," Futures, 51, 31-49.
Hines A (2020), "Evolution of framework foresight", Foresight, Published online 26 June 2020. https://doi.org/10.1108/FS-03-2020-0018

Strategic Foresight is a genre of methodologies that provides a framework for sense-making of data generated by structured processes to identify both trends and driving forces. Appreciating trends and driving forces will provoke insights to map out possible futures. Sense-making of insights expands and reframes the range of strategic options that need to be taken into consideration before strategic decisions are made to shape the future.

For PAS LAB, we employ the "Framework Foresight" developed by Drs. Andy Hines and Peter Bishop at the University of Houston's Foresight program (Hines and Bishop 2013, Hines 2020). The NPSCW has prepared, through an iterative process, the "Foresight Portfolio" [pages 11-30], including curated content from various futurist summaries (i.e., trends, issues, plans and projections) in four domains: 1. Education, 2. Equity, 3. Health, and 4. Technology. Through facilitated roundtable discussion, participants will reflect and interpret foresights to envision future scenarios, then brainstorm and prioritize the key changes that will occur. Through an intuitive sense-making process, participants will realize the future implications (i.e., opportunities and threats). The insights gained are used to inform the development of strategic options.

Generation of Data for Consensus Paper

The collaborative interactive session will include (Part 1) envisioning provocative futures **(FORESIGHTS)** driven by forecasted trends and driving forces through discussion with an expert panel of visionaries in academic medicine and bioscience, (Part 2) using the foresights to invoke **INSIGHTS**, the "Aha!" about opportunities and threats to sustaining the pediatric physician-scientists workforce, through structured, roundtable discussion with invited participants. Inherent to Insights are strategies to create competitive edges for the future physician-scientists. The NPSCW will synthesize collected data to develop strategic planning or **ACTION** (Part 3). We will capitalize on the outputs of this conference through continuing engagement with communities and stakeholders at our ThinkPOD. Multiple touchpoints of engagement will help form a robust network of trainees, faculty, program leaders, medical education professionals and pediatric physician-scientists from diverse regions and with diverse types of leadership roles. This PAS Lab will develop shared solutions to sustaining the pediatric physician-scientist workforce with planned continued dialogue post-PAS.

The Foresight-to-Insight-to-Action is a process developed and used by the Institute for the Future (Johansen 2007, Johansen 2017).

Identifying the Future of Pediatric Physician-Scientists

Expert Panelists

1. **Leslie R. Walker-Harding, MD, FAAP, FSAHM**, Chair, Department of Pediatrics, Senior Vice President and Chief Academic Officer, Seattle Children's Hospital
2. **Rohan Hazra, MD**, Director, Division of Extramural Research, NIH-NICHD
3. **Robin Lorenz, MD, PhD**, Executive Director Research Management, Research Pathology, Genentech
4. **Michele Mariscalco, MD, MHA, FCCM, FAAP**, Assistant Vice Chancellor, Health Associate Dean, Systems-Based Practice, University of Illinois at Chicago
5. **Traci Wolbrink, MD, MPH**, Co-Founder and Co-Director, OPENPediatrics, Boston Children's Hospital

Roundtable Discussion Chairs

1. **Beth Tarini, MD, MS**, President, Society for Pediatric Research, Children's National Medical Center
2. **Bob Vinci, MD**, Co-Chair, AMSPDC Workforce Initiative, Chairman of Pediatrics, Boston University Medical Center
3. **Catherine Gordon, MD, MS**, Chair of Pediatrics, Baylor College of Medicine
4. **Mary Leonard, MD**, Chair of Pediatrics, Stanford University School of Medicine
5. **Leslie Walker-Harding, MD**, Chair, Department of Pediatrics, Senior Vice President and Chief Academic Officer, Seattle Children's Hospital
6. **Rohan Hazra, MD**, Director, Division of Extramural Research, NIH-NICHD
7. **Robbin Lorenz, MD**, Executive Director Research Management, Research Pathology, Genentech
8. **Michele Mariscalco, MD, MHA, FCCM, FAAP**, Assistant Vice Chancellor, Health Associate Dean, Systems-Based Practice, University of Illinois at Chicago
9. **Traci Wolbrink, MD, MPH**, Co-Founder and Co-Director, OPENPediatrics, Boston Children's Hospital
10. **Sallie Permar, MD, PhD**, Chair of Pediatrics, Weill Cornell
11. **Joseph Gigante, MD**, Professor of Pediatrics, Vanderbilt University
12. **Rebecca Blankenburg, MD, MPH**, President, Association of Pediatric Program Directors, Vice Chair of Education, Stanford University School of Medicine, Stanford Children's Hospital
13. **Stephanie Davis, MD**, Charles Everett and Katherine M. Brewer Professor of Pediatrics, Chair, Department of Pediatrics, UNC Chapel Hill

Facilitator Chairs

1. **Caroline Rassbach, MD, MAEd**, Residency Program Director, Stanford Children's Hospital
2. **Catherine Forster, MD, MS**, Assistant Professor, University of Pittsburgh School of Medicine, UPMC Children's Hospital of Pittsburgh

NPSCW Facilitators

1. **Oleh Akchurin, MD, PhD**
2. **Kate Ackerman, MD, MBA**
3. **Debra Boyer, MD**
4. **Bobbi Byrne, MD**
5. **Danielle Callaway, MD, PhD**
6. **Catherine Forster, MD, MS**
7. **Rasheed Gbadegesin, MBBS, MD**
8. **Candace Gildner, MD, PhD**
9. **Fernando Gonzalez, MD, PhD**
10. **Kelly Harris, MD**
11. **Jacqueline Ho, MD**
12. **Daniel Moore, MD, PhD**
13. **Jordan Orange, MD, PhD**
14. **Suong Nguyen, MD, PhD**
15. **Weston Powell, MD, PhD**
16. **Caroline Rassbach, MD, MAEd**
17. **Mark Ward, MD**

Table Assignments

Table #	Domain	Table Discussion Chairs	Table Discussion Moderators
1	EDUCATION	**Catherine Gordon, MD, MSc** J.S. Abercrombie Professor and Chair, Pediatrics Baylor College of Medicine/ Texas Children's Hospital	**Caroline E. Rassbach, MD, MAEd** Clinical Associate Professor, Pediatrics Pediatric Residency Program Director Stanford School of Medicine
2		**Joseph Gigante, MD** Professor of Pediatrics, Vanderbilt University **Stephanie Davis, MD** Charles Everett and Katherine M. Brewer Professor of Pediatrics Chair, Department of Pediatrics UNC Chapel Hill	**Daniel Moore, MD, PhD** Assistant Professor, Pediatrics Physician-Scientist Training Program Director Vanderbilt University
3		**Rohan Hazra, MD** Director, Division of Extramural Research Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD)	**Catherine Forster, MD, MS, FAAP** Assistant Professor, Pediatrics University of Pittsburgh Medical Center **Suong Nguyen MD, PhD** Infectious Disease Fellow, Pediatrics Washington University School of Medicine in St. Louis
4		**Michele Mariscalco, MD, MHA, FCCM, FAAP** Assistant Vice Chancellor of Health Sciences for Academic Affairs Professor of Pediatrics Associate Dean for Systems-Based Practice University of Illinois College of Medicine	**Mark Ward, MD** Associate Professor, Pediatrics Baylor College of Medicine/ Texas Children's Hospital **Kelly Harris, MD** Hospice and Palliative Medicine Fellow University of Pittsburgh Medical Center

Table #	Domain	Table Discussion Chairs	Table Discussion Moderators
5	EQUITY	**Beth Tarini, MD, MS, MBA** Associate Director, Center for Translational Research Children's National Research Institute Children's National Hospital Associate Professor of Pediatrics, The George Washington University President, Society for Pediatric Research	**Debra Boyer, MD, MHPE** Chief Medical Education Officer and DIO Pediatric Pulmonologist Nationwide Children's Hospital **Weston Powell, MD, PhD** Pediatric Pulmonary and Sleep Medicine Fellow, University of Washington School of Medicine, Seattle Children's Hospital
6		**Leslie R. Walker-Harding, MD, FAAP, FSAHM** Ford/Morgan Endowed Professor Chair Department of Pediatrics/Associate Dean University of Washington Chief Academic Officer/Senior Vice President Seattle Children's Hospital	**Bobbi Byrne, MD** Vice Chair of Education, Pediatrics Professor Riley Children's Hospital
7		**Rebecca Blankenburg, MD, MPH** Clinical Professor, Pediatric Hospital Medicine Associate Chair of Education, Pediatrics Assistant Dean of Graduate Medical Education Stanford School of Medicine	**Jordan S. Orange MD, PhD** Reuben S. Carpentier Professor and Chair Department of Pediatrics, Vagelos College of Physicians and Surgeons Columbia University Physician In-Chief, Morgan Stanley Children's Hospital New-York Presbyterian
8	HEALTH	**Mary Leonard, MD** Arline And Pete Harman Professor and Professor Of Medicine, Nephrology, Epidemiology And Population Health Stanford School of Medicine	**Oleh Akchurin, MD, PhD** Assistant Professor of Pediatrics, Pediatric Nephrology Associate Director, Pediatric Physician Scientist Training Program Rohr Family Clinical Scholar Weill Cornell Medicine New York-Presbyterian Phyllis and David Komansky Children's Hospital
9		**Sallie Permar, MD, PhD** Nancy C. Paduano Professor and Chair Department of Pediatrics, Weill Cornell Medicine Pediatrician-in-Chief New York-Presbyterian Komansky Children's Hospital Weill Cornell Medical Center	**Danielle Callaway, MD, PhD** Neonatology Fellow Children's Hospital of Philadelphia **Fernando Gonzalez, MD, PhD** Assistant Professor, Pediatrics PSTP Director University of California- San Francisco

Table #	Domain	Table Discussion Chairs	Table Discussion Moderators
10	TECHNOLOGY	**Robin Lorenz, MD, PhD** Executive Director, Research Pathology Genentech	**Rasheed Gbadegesin, MD, MBBS** Professor of Pediatrics and Professor in Medicine Duke University Medical Center Faculty Member, Duke Molecular Physiology Institute
11		**Traci Wolbrink, MD, MPH** Co-Director, OPENPediatrics Senior Associate in Critical Care Medicine, Boston Children's Hospital Associate Professor in Anesthesia, Harvard Medical School	**Kate Ackerman, MD, MBA** Professor of Pediatrics (Critical Care) Senior Vice Chair, Innovation & Integration University of Rochester Director, Pediatric Sedation Golisano Children's Hospital, Rochester, NY Co-Chair, National Pediatrician-Scientist Collaborative Workgroup
12		**Robert J. Vinci, MD** Chief of Pediatrics Boston Medical Center Joel and Barbara Alpert Professor of Pediatrics Chair, Department of Pediatrics Boston University School of Medicine	**Candace Gildner MD, PhD** Assistant Professor of Pediatrics and Biomedical Engineering Director of the Pediatric Residency Research Track Division of Pediatric Hospital Medicine

Agenda

		Notes
1:00 pm - 1:10 pm	**Kate Ackerman, MD, MBA** **WELCOME** Research Disclosures Ongoing Workforce Initiatives Summary Session Agenda	
1:10 pm - 1:15 pm	**Jordan Orange, MD, PhD** **SESSION TASK** Looking Into The Future – 10 Years Introduction of Foresight-Insight-Action Framework	
1:15 pm - 1:30 pm	**Jordan Orange, MD, PhD**, Moderator **EXPERT PANEL DISCUSSION** **Leslie Walker-Harding, MD** **Michelle Mariscalco, MD, MHA, FCCM, FAAP** **Rohan Hazra, MD** **Traci Wolbrink, MD, MPH** **Robbina Lorenz, MD, PhD** Panel Sharing " I Believe.... and I Project" Statements (10') Audience Real Time Survey – Sharing Statements (5')	
1:30 pm - 1:40 pm	**Audrea Burns, PhD** **HIGHLIGHT OF FORESIGHTS** Introduction to Workshop Process	
1:40 pm - 2:05 pm	**ROUNDTABLE DISCUSSIONS** Table Chair / Table Moderator Guiding Through Key Questions	
2:05 pm - 2:15 pm	**REPORT OUT** **Kate Ackerman, MD, MBA**, Moderator Per Facilitator - 2 Key Points Selected Tables / Domain **Education** 1. Speaker: **Daniel Moore, MD, PhD** (Table Chairs: **Joe Gigante, MD** / **Stephanie Davis, MD**) 2. Speaker: **Carrie Rassbach, MD, MEd** (Table Chair: **Catherine Gordon, MD**) **Equity** 1. Speaker: **Bobbi Byrne, MD** (Table Chair: **Leslie Walker-Harding, MD**) 2. Speaker: **Debra Boyer, MD** (Table Chair: **Beth Tarini, MD**) **Health** 1. Speaker: **Catherine Forster, MS, MD** (Table Chair: **Mary Leonard, MD**) 2. Speaker: **Fernando Gonzalez, MD, PhD** (Table Chair: **Sallie Permar, MD, PhD**) **Technology** 1. Speaker: **Kate Ackerman, MD, MBA** (Table Chair: **Traci Wollbrink, MD**) 2. Speaker: **Candace Gildner, MD, PhD** (Table Chair: **Bob Vinci, MD**)	
2:15 pm - 2:25 pm	**Dan Moore, MD, PhD**, Moderator **MODERATOR PARTICIPANT FEEDBACK: OPEN FORUM** Reaction to Insights	
2:25 pm - 2:30 pm	**Kate Ackerman, MD, MBA** **CLOSING REMARKS** Future Sessions Survey Completion	

A Big Gratitude & Your Tasks

1. **Expert Panel Discussion**
   A. The panel discussion is 15 minutes total.
   B. Goal- Each panelist will share two statements to succinctly relay thoughts on the future of the pediatric physician-scientist workforce. These statements will also be completed by all session participants and will be gathered through real time polling.
      1. Statement 1: I believe….
      2. Statement 2: I project…

2. **Past & Current Strategic Aim**
   A. Many groups have recently worked to identify the significant complexities in fixing the "leaky physician-pipeline in pediatrics". Identification of barriers and strategies has been the ongoing work of the NPSCW and many pediatric societies(Barrett et al. 2020; Permar et al. 2020; Burns et al. 2020; Vinci, Degnon, and Devaskar 2021; Macy et al. 2018; Turner et al. 2021; Catenaccio, Rochlin, and Simon 2021). At the PAS Lab, we TRANSITION focus from identification of solutions for these problems to thinking about the future of the physician-scientist workforce of 2032.
   B. Focusing on the future physician-scientist workforce aligns with parallel/recent work by the Accreditation for Graduate Medical Education (ACGME) to redefine future competencies for pediatrics and by the Association of American Medical Colleges (AAMC) to define future roles for medical educators (Simpson et al. 2018) as well as the future landscape of Graduate Medical Education (Simpson et al. 2020).

3. **Frameshifting -- Be a Futurist:** Put your "Futurist" lens on and continue reflecting upon our central question across all sessions – what will be the professional skills needed of the 2032 Pediatric Physician-Scientist?
   A. "Futures thinking is not about predicting the future; rather, it is about engaging people in thinking deeply about complex issues, imagining new possibilities, connecting signals into larger patterns, connecting the past with the present and the future, and making better choices today" (Marina Gorbis, Educause 2019)
   B. It may help you to think about how the "physician-scientist" roles have changed from when you started training or when you started supporting trainees. How much has changed and what continues to change?
   C. Consider what you hear, read, watch, and say throughout the process of preparation and during the sessions – will that impact the 2032 physician-scientist in pediatrics?

4. **Review the Foresight Portfolio and Agenda**
   A. The "Foresight Portfolio" includes curated content from various futurist summaries in four domains: Health, Education, Technology and Equity.
   B. We compiled futurist summaries from four different reputable futurist academies, curated the content through a consensus discussion at the NPSCW March monthly meeting, and finalized the trends and driving forces that will influence the future world in one portfolio.
   C. The agenda provides information about the whole PAS Lab series though your role will be confined within the 30-minute Discussion.

Definitions

A. Strategic Foresight: A genre of methodologies that provide a framework for making sense of data generated by structured processes to identify trends and driving forces, thereby provoking insights to map out possible futures. Sense-making of insights expand and reframe the range of strategic options that need to be taken into consideration before strategic decisions are made to shape the future.

B. Trend: A projection from an analytic process with appearance of variables from increasingly heterogeneous contexts that move in the same direction – what seems to be happening. Trends usually are identified by methodical analyses and/or by experts who are well aware of the latest changes within their fields, and have a recognizable development path, and illustrate value shifts already begun with existing logics (Veros 2003).

C. Driving Force: A cluster of trends derived from an interpretive process connecting different trend reports and understanding the implications of multiple events-- identifying what is really happening. It defines critical transformations or landscapes of long-term changes (Veros 2003).

D. Futures: A view of alternative futures derived from a prospective process to envision what might happen, and thus always be addressed in plurality. **The key to this process is to shift the mental model of participants – to open up their thinking to what might be possible, as opposed to business- as-usual thinking around what they believe is possible and will occur.** It is about shifting the focus and thinking from short term to long term. This process could be strengthened by a process of sense-making, focusing on the feelings and beliefs as well as external trends.

5. **Roundtable Discussion**

There will be approximately 12 tables. Each table will be assigned to discuss one of the four domains and moderated by an invited expert/chair and a facilitator (assignments will be made in advance). The chair will take a primary role in moderating the discussion whereas the facilitator will ascertain the structure of the discussion going through steps and address all questions (See the Worksheet on page 35):

A. **STEP ONE: DETERMINING KEY CHANGES**–Through your reflection and interpretation of trends and driving forces within the domain of (Education, Equity, Health, or Technology), brainstorm and prioritize the key changes that will occur (10-15 min. maximum). Please list ones that you did not (or did) read. Use these to answer the questions in step 2.

Examples of key changes for each domain (that may arise from your table):

1. **Education** – no traditional classrooms, all skill-based (not discipline specific)
2. **Equity** – universal holistic admissions
3. **Health** – universal genome sequenced at birth, genomic editing more normalized, combination of subspecialties, widespread use of biomaterials
4. **Technology** – artificial intelligence, advanced computing

B. **STEP TWO: PROVOKING INSIGHTS**–Envision yourself in the "futures", influenced by the key changes from Step One, and consider the following questions:

1. What are the implications (potential opportunities & threats*) of the futures for physician-scientists?
2. What are characteristics (i.e., job roles) of the physician-scientists who will best be able to take advantage of the new opportunities?
3. How will the physician-scientists who face the potential threats adapt their "job roles" to thrive in the futures?

*Opportunities and threats may pertain to several factors including, but not limited to, financial, medical, governmental, security, and cultural Impacts.

C. **GUIDING PRINCIPLES FOR EFFECTIVE DISCUSSION**

1. Foresights are a good way to provoke insights even if you do not believe in the forecasts (trends or driving forces).
2. Generating insights is a process of sense-making focusing more on feeling, beliefs, and intuition rather than analysis or evidence base.
3. Insights build agility (being adaptive to things that would have been overlooked otherwise) and lead to clarity (what should we do now to prepare), and not certainty (the definitive answer about the future).
4. Be flexible. Some may spend more time deriving the driving forces than others, but make sure to spare at least ½ of the time to generate insights.
5. Converse within the assigned domain, but no need to correct/redirect the conversation as it may compromise the flow of insights (make note anyway, the data will still be useful).
6. Document the discussion aimed at collecting insights, and not making note verbatim.
7. Clarify the points whenever possible, but it is ok to document your interpretation of the conversation.

6. **Report Out**

A. Each facilitator will report only for 1 min (a couple of distinctive points – 10-15 min. maximum).

B. This report out is not meant to be informative, but to provoke additional insights from participants.

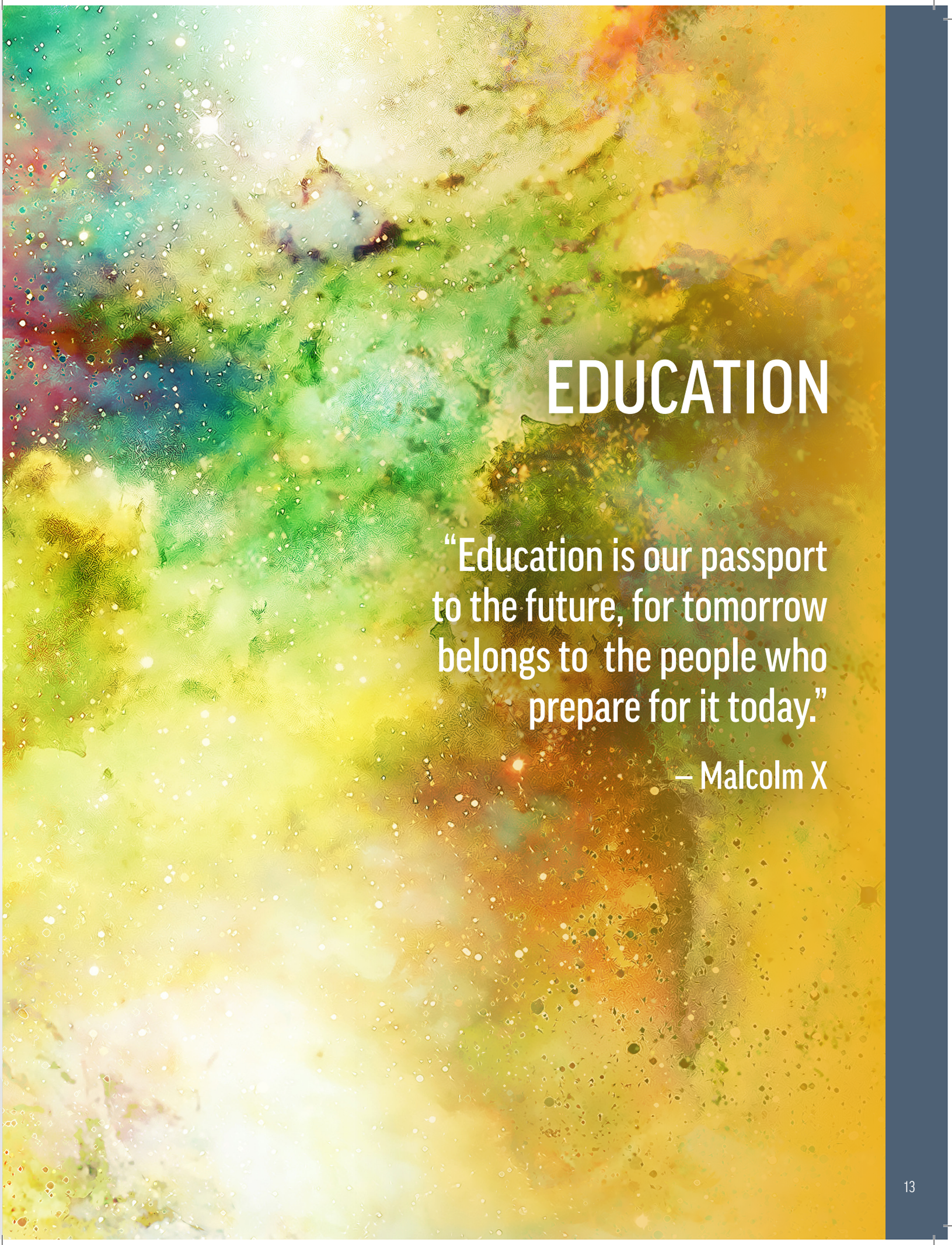
C. Data will be compiled real time using survey monkey. There will be a separate parallel survey for all facilitators that will allow for ample writing/space/note taking for each question.

Acknowledgment

We would like to thank Dr. Deborah Simpson for her expertise and guidance in preparation of this session. Furthermore, we would like to thank all members of the National Pediatrician-Scientist Collaborative Workgroup for generation of consensus trends in curating the "Foresight Portfolio."

FORESIGHT PORTFOLIO

NOTES



EDUCATION

"Education is our passport to the future, for tomorrow belongs to the people who prepare for it today."

– Malcolm X

TRENDS IN EDUCATION

Summary

Our society never stops changing, and we never stop learning. As a result, our education systems are under constant pressure to incorporate new ideas and new technologies, which ultimately allows us to develop innovative means of inspiring the next generation. **Below are trends within education that have the potential to impact future roles of pediatric physician-scientists.**

1. **The adoption of Tele-Education, Remote Instruction, Online Learning and the "Gamification" of Training and Education will advance rapidly**

   Taking classes online has dramatically accelerated on a global basis the past few years. Blended learning using a combination of online and in-classroom instruction, together with instructional chatbots and AR and VR tools, will increasingly be used to give students an immersive experience as the need for retraining and reskilling continues to grow. Education and training will increasingly focus on accelerating learning by using advanced simulations and skill-based learning systems that are self-diagnostic, interactive, game-like and competitive. By making the experience fun, engaging and personalized, learning will improve, and the use of gamification or competition will spread. Massive open online courses (MOOC) have already been embraced by highly recognized and traditional educational institutions, putting them in a position to make location and tuition far less of a barrier to receiving information, training and knowledge needed to succeed in a rapidly changing world.

2. **Virtual Reality (VR), including the Metaverse, Augmented Reality (AR) Applications and Digital Twins, will shift from a rapid evolution to a revolutionary level of applications**

   Augmented reality allows users to point a digital camera using a smartphone or AR glasses at something and overlay just-in-time information about the subject they are focusing on. Soon, Apple and others will be selling conventional-looking AR glasses that allow wearers to overlay data on their fields of vision, providing useful information about what they're looking at. Business applications for AR glasses will grow rapidly. By contrast, Virtual Reality uses oversized headsets to shut out the real world and provide an immersive, computer-generated 3D environment with which the wearer can interact. Thanks to new relatively low-cost hardware, new commercial applications for specific industries are rapidly growing. AR and VR have already shifted from a single user to a multiuser social experience now being referred to as the Metaverse thanks to Facebook's name change to Meta, and that will drive accelerated growth for both business and gamers in the near future.

3. **Citizen Science**

   Science is no longer relegated to sterile labs or experts with advanced degrees. With the help of technology, average citizens are able to engage in real scientific discovery and research in their own homes and backyards. Their data collection, analysis and experiments have led to major breakthroughs and advancements. The original purpose of citizen science was to assist researchers in classifying images. With the combined effort of thousands of people, the work can be accomplished in a fraction of the time. For example, this method has been used to tackle climate issues by tapping into the power of the crowd with initiatives such as MIT's Climate CoLab. Alternatively, some patients with rare diseases or conditions voluntarily divulge their medical information, helping researchers and others to gain insight into little-known illnesses. Recognizing that good science can come from anywhere could propel us toward unprecedented discoveries. Researchers created the public-facing game Quantum Moves to solve roadblocks in quantum computing. By mapping the mouse positions of players, thousands of citizen scientists can solve the problem quicker than algorithms. To develop a global innovation ecosystem, Johnson & Johnson launched a contest for the public to envision the future of healthcare. These crowdsourced initiatives have the power to speed up scientific breakthroughs.

4. **Virtual Workplaces**

   The days of the 9 to 5 job are coming to an end. Due to the ubiquity of digital and virtual technologies, individuals can work remotely from anywhere in the world. This landscape of intangibility may reframe the issue of work/life balance, and even allow people to be more connected than ever before. In today's globalized world, employees can be scattered across the globe and "offices" can exist in virtual spaces. By using a combination of tools designed to alleviate tensions of dispersed teams, coworkers can collaborate on projects while remaining in different locations. Some even suggest that by working from home and allowing coworkers into our "personal" lives, teammates get a better understanding of who we are and what is important to us. This allows employees to be more authentic with one another,

and ultimately improves collaboration. Contrary to popular belief, tests have begun to demonstrate that virtual interactions can enhance our ability to gain acceptance, negotiate or reach agreement in a way that physical contact cannot. In a variation of the Midas Touch effect – the ability to direct decisions and actions through social touch – researchers not only replicated the influence of physical interaction from person to person in a virtual space, but have shown that the effect can be duplicated even when an individual is interacting with a large group by using haptic technology.

5. **Knowledge Became a Free for All**
   In what has been called a "life-changing decision," the European Union's ministers of Science, Innovation, Trade, and Industry decided to give individuals free access to science papers. This impacts research supported by public and public-private funds, which are a vast portion of the papers produced annually; however, the goal is to make all science freely available by 2020. Ultimately, the commitment rests on three main tenets: sharing knowledge freely, open access, and reusing research data.

6. **The Age of the Computer Led to a New Age in Education**
   At the Summit on Computer Science Education in September the White House announced a new initiative that will give every student from kindergarten through high school access to a computer science education. Specifically, the program will provide each student with the in-demand computer science skills that are needed to join the world's workforce and, thus, help prepare them to build the world of tomorrow.

7. **Students Taking to the Skies**
   The European Emergency Number Association, a nonprofit trade body that is supported by DJI, a Chinese drone maker, started a drone school in Copenhagen that aims to help government agencies transform drones from recreational toys to life-saving tools. Ultimately, the school launched a six-month trial that is the world's largest and most widespread experiment with unmanned aircraft.

8. **Our Classrooms Literally Disappeared**
   In February, the SP Jain School of Global Management announced plans to launch its undergraduate and graduate classes in virtual reality. The school's president explained that the decision to have courses with virtual reality as a major component was prompted by the changing needs of business. The school notes that, as virtual reality becomes more ubiquitous, students need to learn how to work in the virtual world as well as know how to work the old-fashioned way – and that means being fully immersed in the virtual world throughout schooling.

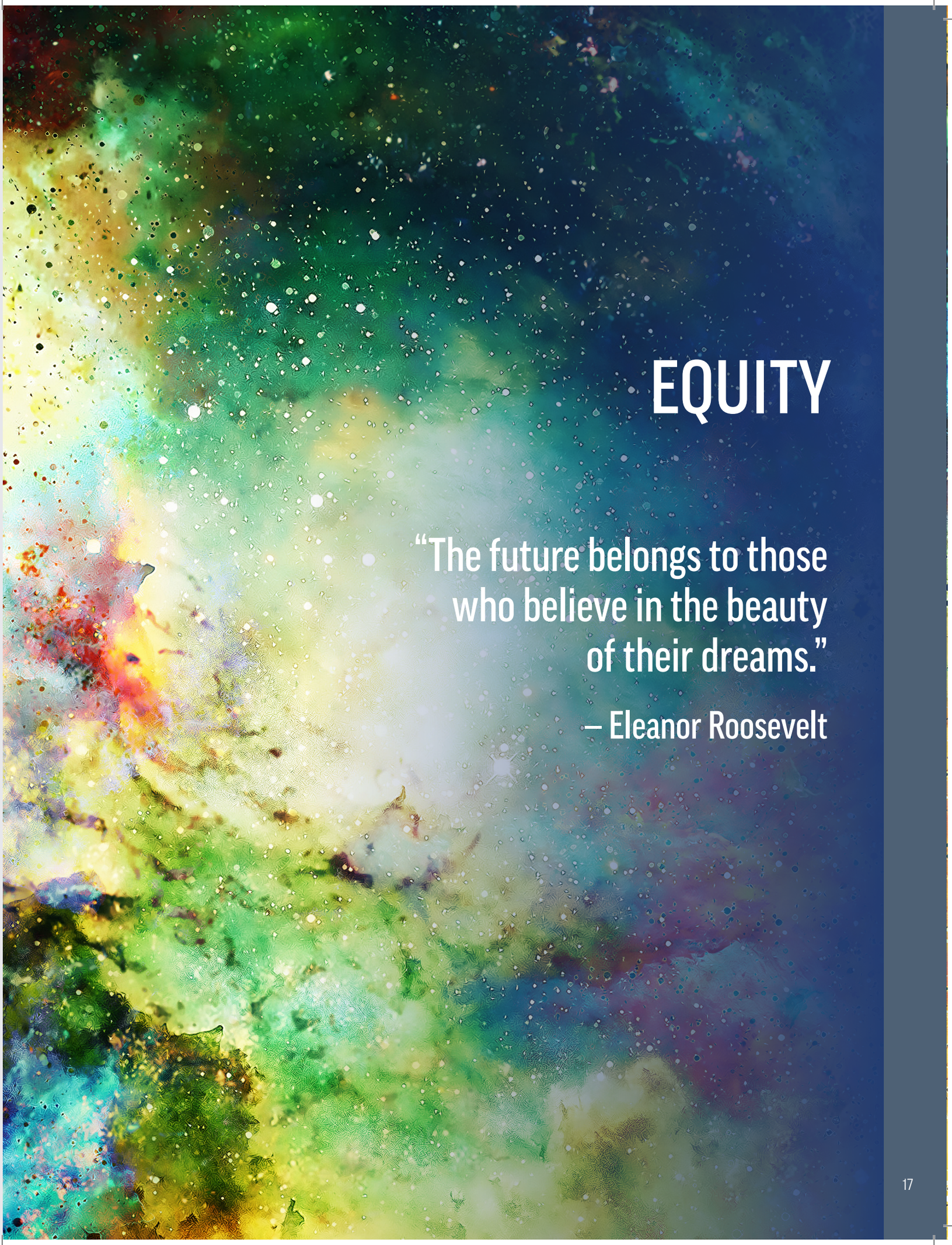
9. **A New Way to Tackle Learning Disabilities**
   A new study published in the journal Molecular Psychiatry indicated that DNA could be used to accurately predict an individual's academic achievement, which could prove useful in helping us identify children that could have learning difficulties and develop solutions before they fall behind. The work was based on a genome- wide association study that examined almost 10 million single nucleotide polymorphisms and identified 74 genetic variants.

10. **Re-Creating Our Teachers**
    Ahshok Goel, a professor at Georgia Institute of Technology, revealed in May that he has been employing a robot as one of his teaching assistants. "Jill Watson" did the work of a regular teacher's assistant for Goel, answering students' questions in a forum, reminding students of upcoming important dates over email, and communicating on a daily basis. Notably, the AI did so in a way that was so human, students never realized that they were talking to a robot. To train the robot, Georgia Tech researchers exposed Jill to over 40,000 postings in the discussion forum "Piazza, "and he taught her to use previous responses to reply to related questions.

Based on the trends and driving forces you have reviewed in the domain of Education:

1. **What will be the key changes that shape the future?**
2. **What makes you nervous (i.e., uncertainty and threats)?**
3. **What gives you hope (i.e., new opportunities)?**

YOUR NOTES



EQUITY

"The future belongs to those who believe in the beauty of their dreams."

– Eleanor Roosevelt

TRENDS IN EQUITY

Summary

A combination of policies and technological innovations favoring the wealthy has created the greatest concentration of assets in nearly a century. Economic opportunities, health outcomes, and political power have moved beyond the grasp of all but the wealthy. The next decade will see elites collide with the broader population's increasing intolerance of inequality, deprivation, and denial of dignity. While these power struggles will play out differently across regions, they will produce new social and regulatory frameworks to address problems with the valuation and concentration of global assets. **Below are trends within equity that have the potential to impact future roles of pediatric physician-scientists.**

1. **Inclusive Policies as Competitive Advantage:** Increasingly large bodies of evidence are showing that companies that hire for neurodiversity–particularly by developing hiring programs for those on the Autism spectrum– outperform their peers. Similar research from Accenture is showing that workplaces that champion best practices for supporting persons with disabilities are significantly more profitable than those that don't. These kinds of efforts are reframing inclusive design as an opportunity to both promote more humane policies and create new business value.

2. **Dream Hoarding:** Upper-middle-class parents will go to extreme lengths to ensure their children's economic security–creating neighborhood enclaves that keep out lower income families, gaming the college application process, and using social connections to set up opportunities for their kids. Wealth will become more important in determining life outcomes. Background Facts: Students admitted to Harvard and Stanford in 2017 had a parent who attended the university. Children of Harvard alumni were five times more likely to be admitted than other applicants. Although education is typically viewed as the main route for upward mobility, these practices give clear advantages to the privileged and directly limit the opportunities of others. Cnbc.com. Thecrimson.com. Npr.org.

3. **Unaccountable Wealth:** Innovations in Fintech asset management will enable the wealth to quietly move money out of the formal financial system, beyond the reach of government regulation and taxation. Attempt to reduce wealth inequality through government policy will be stymied by the inability of governments to regulate increasingly mobile hidden assets. Background Facts: private wealth in the world is stored in tax havens. About $21 to $32 trillion is beyond the reach of government regulation and taxes. This results in an estimated $500 billion in lost annual tax revenue for governments globally, which could otherwise be put toward providing services and public goods. A few locations have become global tax haven centers. Nearly $6 trillion is stashed in Luxembourg, and $4 trillion in the Cayman Islands. Sources: taxjustice.net. nber.org/papers/w23805, nber.org/papers/W 24701, forbes.com

4. **Demands for Universal Basic Assets:** Expect struggles over whether key assets, including housing, health care, education, childcare, food, and water should be held by private or public markets. Regions with high costs of basic needs will wrestle with whether the market will offer affordable, vital assets, while those left out will demand that governments guarantee their provision. Background Facts: Unrest erupted in France at the end of 2018. While it was sparked by a rise in fuel taxes, the yellow vest movement was a response to the social costs of rising inequality and wealth concentration, highlighting a looming conflict over how resources should be distributed. Resource: bbc.co.uk.

5. **Educational Models:** Most students today are educated in much the same way as their counterparts of a previous era, with a one-size-fits-all, predominantly analog approach. Ballooning college tuition costs coupled with a growing disconnect between dated curriculums and a rapidly changing world suggests a sector that is ripe for disruption. Innovative startups are leveraging technology and flipped business models to disrupt higher education, which has remained largely untouched for centuries. For example, Piazza, a free online study room boasting 1.25 million global students, allows anonymous Q&A between students and their professors. The site monetizes the experience by allowing recruiters access to users. Understanding the need to think beyond MOOCs, other entrepreneurs such as The UnCollege Movement are reimagining college with a curated, year-long set of experiences instead of classes. The challenge of innovating education in our increasingly complex environment is preparing students for jobs that do not exist today. With automation set to disrupt 800 million jobs by 2030, many experts have begun promoting a vision of "hybrid education," where siloed studies give way to complex, interconnected educational models inclusive of experiential study. In this way, a network of people, ideas and machines could create a more human-centric approach to education, one that develops the unique skill sets needed in our highly connected world.

6. **Crowdsourcing:** Using the power of the Internet, companies or individuals can leverage the crowd for assistance with ideas, solutions, labor or funding. The combination of bottom-up and top-down processing in crowdsourcing leads to more efficient and diverse solutions. Our connected world is empowering humanity as never before. Wikipedia, the online user-generated encyclopedia, is among the earliest and most well-known examples of crowdsourcing. Knowledge curation, however, was just the start of crowdsourcing's impact on the world, with swarms of individuals now commonly collaborating to solve innovation problems. Elon Musk, creator of Tesla Motors, pitched a hypersonic ground transportation system, the Hyperloop, and internet crowds are making his vision a reality. NASA also uses the assistance of non-experts when designing robots and waste management systems for space. Leveraging the power of the crowd is now commonplace in product development and problem solving, but what about crowdsourcing entire organizations or governments? Athleisure retailer Orin is allowing its consumers' preferences to guide all of its business decisions: from ad campaigns, to manufacturing locations, to the product line. The nonprofit Mindfire is working to decode human intelligence by crowdsourcing ideas from great thinkers in a variety of scientific fields. If successful, this could pave the way to government powered by the people.

7. **Mitigating Disparities:** The nascent field of precision medicine promises effective treatment for difficult illnesses, but creates risks related to privacy, misinformation, and demographic inequality. Poor representation of specific groups in reference data will bifurcate the market to serve a genetic-enabled mainstream, further shifting power to those groups.

8. **Social and Digital Identities Co-evolve:** Digital tools positioned as ways for individuals to better express their identities and interests get turned into fodder for better marketing and targeting. Facebook's expanded gender options enable enhanced ad targeting. In recent years, Facebook has expanded its gender field beyond a binary definition of gender to include at least 58 gender categories. Hailed as an important shift for a more inclusive design of the platform, this expansion of gender identification also opens up new ways to target ads within its platform.

9. **Irreversible Black Box Decisions:** Algorithmic tools designed to support decision-making become final arbiters of high impact decisions. Automated system fires well-regarded teacher. A middle school teacher at MacFarland Middle School in Washington DC, was fired because her students' testing scores failed the school district's evaluation algorithm, even though students and parents rated her highly. She was immediately hired by a school that doesn't use algorithmic evaluation.

10. **Shifting Problems Upstream:** As the evidence base for preventive health continues to grow, multi-stakeholder approaches will push health interventions to earlier ages with a focus on social rather than medical services. Identifying adverse childhood experiences (ACEs) is important for preventing lifelong health challenges. California's new surgeon general has prioritized the prevention of childhood trauma, which research links to major downstream consequences for wellbeing and clinical health.

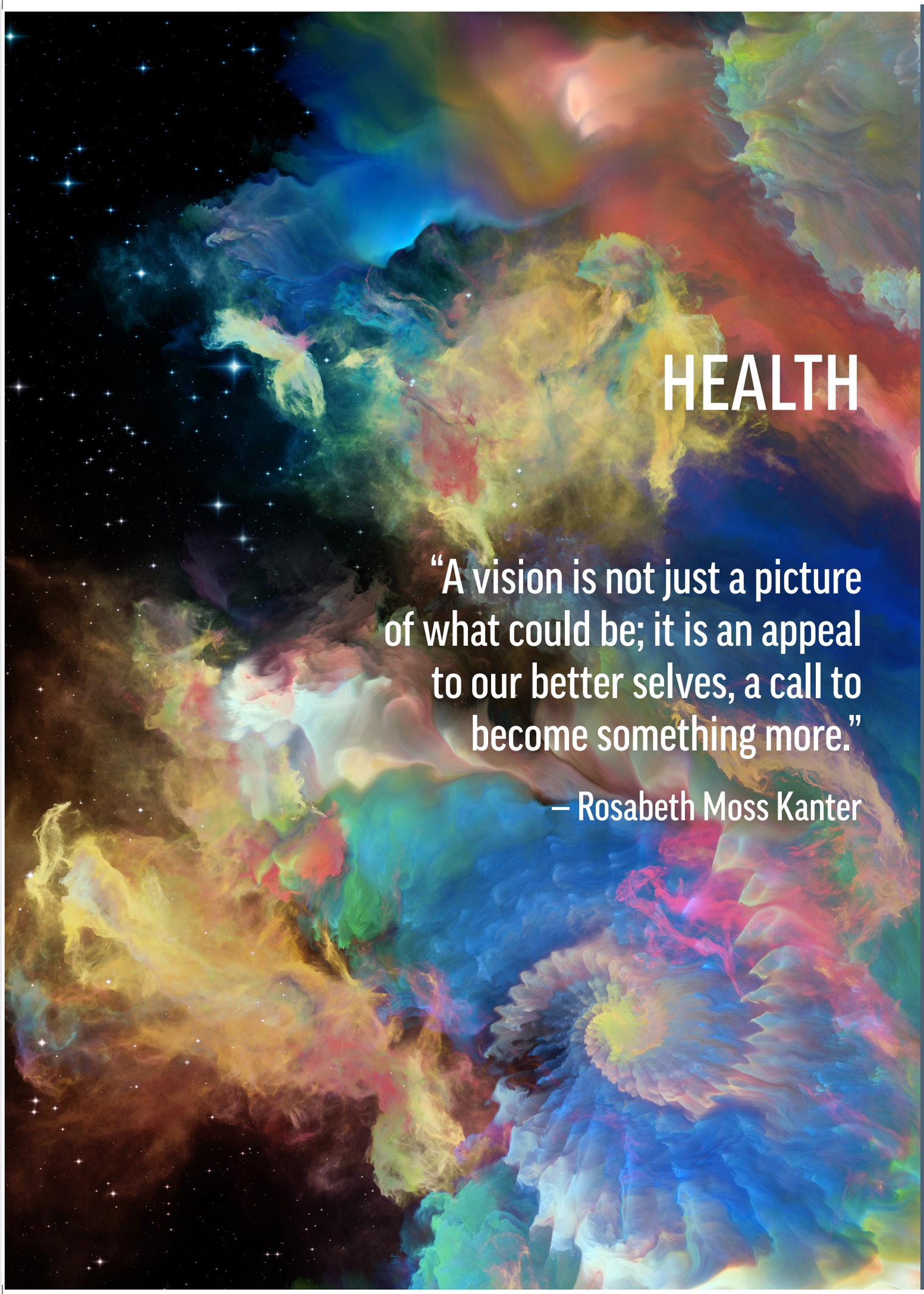
Based on the trends and driving forces you have reviewed in the domain of Equity:

What will be the key changes that shape the future?

What makes you nervous (i.e., uncertainty and threats)?

What gives you hope (i.e., new opportunities)?

YOUR NOTES



HEALTH

"A vision is not just a picture of what could be; it is an appeal to our better selves, a call to become something more."

– Rosabeth Moss Kanter

TRENDS IN HEALTH

Summary

In the domain of health, power has traditionally been held by doctors, hospitals, drug companies, and research institutions that "fix" us when something goes wrong, extending our lifespans compared to previous generations. However, as populations become longer-lived but sicker, power will shift toward those who can prevent impairment, mitigate pain, and help manage and maintain quality of life. New scientific breakthroughs and technologies will bolster these efforts, but they also hold the potential to disempower specific populations and create new disparities. **Below are trends within health that have the potential to impact future roles of pediatric physician-scientists.**

1. **Accelerating use of wearables driven by a growing list of advanced sensors will increasingly provide a personalized way to monitor and diagnose physical and mental problems, as well as offer new levels of communication and collaboration capabilities:** Wearables will increasingly be used for both personal and business applications as 5G and other technologies converge to create new value streams and accelerated growth. Apple, with its smartwatch fitted with an increasing number of health sensors and software, joins Google, Samsung and others in an intensifying battle for market share. An ever-expanding array of new sensors coupled with intelligent software and applications will drive further innovation and sales in other wearable technology. An increasing use of Smart Patches that can be attached to the skin for remote disease management, diagnostics and general health information via wireless transfer will expand the definition of wearables.

2. **Advances in 3D Printing (Additive Manufacturing) is moving from rapid evolution to revolution and it is rapidly being applied to an ever-expanding number of industries:** Both customized and personalized manufacturing of finished goods using 3D printing has been growing exponentially and, thanks to global supply chain disruptions, has been accelerated to a new level. 3D printers build things by depositing material, typically plastic or metal, layer by layer, until the product is finished. Originally designed to print prototypes, 3D printers are increasingly being used to print final products, such as jewelry, iPhone cases, shoes, car dashboards, parts for jet engines, buildings, bridges, prosthetic limbs, human jaw bones, blood vessels, organs and much more. This allows companies to manufacture one-of-a-kind or small runs of items quickly, locally and with far fewer costs. 3D printing as a Service will increasingly be offered by companies such as Amazon and FedEx, which will print (manufacture) and ship any CAD design from anywhere to anywhere. And if they don't do it, others will.

3. **Rapid growth of Genomics, Gene Editing with CRISPR, mRNA and Synthetic Biology:** Synthetic biology is a rapidly growing field that combines biotechnology, genetic engineering, molecular engineering and computer science, to name a few, that can be used for designing and building engineered biological systems. Applications include processing information, fabricating materials and structures, producing energy, manipulating chemicals and even producing food. CRISPR is a revolutionary gene editing technology that can be used to create human cellular models of disease, genetically modified organisms to mimic disease and correct genetic mutations to name a few. Advances in AI and other technologies on this list have accelerated gene editing, whole genome printing and synthetic biology, creating a new biology-driven revolution with amazing growth potential. mRNA technology, used to create successful COVID vaccines in record time, will increasingly be used as a new tool to fight current as well as new diseases.

4. **Maker Movement:** DIYers, hackers and makers share a common passion of hands-on tinkering to develop innovative products. This creative class develops not only artwork, technology and tools but even genetically modified organisms, robots and drones. They are inspiring a worldwide maker movement to develop solutions to grand problems. A core element of the maker movement is the ability to bring together a diverse community of individuals, regardless of subject-matter expertise, to collaborate for innovative solutions. Organizations, industries, and institutions are tapping into this inexperienced external perspective to shake up traditional thinking and hack their way to breakthrough ideas. Health for America, for example, is a unique 11-month long program that sponsors four makers with no medical experience and tasks them to develop solutions for healthcare issues such as childhood asthma. A new wave of "biohackers" has arisen, who now have access to gene modification tools such as CRISPR, a system that can target specific stretches of genetic code and edit DNA at precise locations. Though countries such as China and the U.S. are starting to treat patients with gene-editing, some individuals are also experimenting with the cheap and accessible tools in hopes of correcting genetic defects, preventing disease or increasing athletic ability. For better or worse, the genetic genie is out of the box.

5. **Biomimicry:** Engineers, designers and city developers are turning to nature as inspiration for new ideas and products. Some of these innovators are pulling insights from the different forms and shapes of various animals and plants, while others are focusing more on the function through which organisms move, communicate, and survive. Architects and planners are utilizing biomimetic designs to create more sustainable cities. For instance, "smart buildings," made from bone or other organic materials, adopt the self-sustaining attributes of their nature-inspired design elements. Similarly, transportation infrastructure is being influenced by systems in the human anatomy. Mimicking the behavior of the proteins in our cells, for example, Audi's "Flywheel" vehicles are modular and shapeshifting, allowing for more efficient use of resources. Space travel is influencing the way that we view the confines of our world, but venturing out of Earth's atmosphere isn't easy. For instance, the high levels of radiation outside of Earth's magnetosphere could cause irreparable damage to technology in space. However, by learning from the tardigrade, a microscopic and radiation-resistant aquatic organism, we can safeguard our technology. Someday, it may even be possible to genetically modify humans with tardigrade genes, shielding ourselves from the harsh radiation involved with interplanetary travel.

6. **War Against Aging:** Ambrosia, a startup based in Monterey, California, started a clinical trial aimed at rejuvenating people over the age of 35 by injecting them with blood obtained from younger individuals. In the trial, participants undergo plasma transfusions from donors less than 25 years old. Ambrosia tested their blood before the trials began, with the goal of tracking over 100 unique biomarkers. Participants will be retested one month after the procedure to note any improvements in "aged" cells.

7. **Restoration of Brain Function:** Researchers from Stanford University were "stunned" at the positive results they obtained after injecting stem cells directly into stroke patients' brains. After the procedure, one survivor was even able to walk again. The discovery has led researchers to revisit and reevaluate the notion that brain damage is permanent and irreversible. Gary Steinberg, lead author and chairperson of neurosurgery at Stanford, reports that 7 out of the 18 patients who underwent the treatment showed great improvement.

8. **Restoration of Lost Limbs:** A new method that offers a wide range of motion and comfort for amputees became available this summer thanks to a pioneering surgical technique developed by researchers from Johns Hopkins Applied Physics Laboratory. This is a "first" in the field of prosthetics, which has always faced problems when dealing with sockets (the place where the prosthesis attaches to the body). The new procedure is called "osseointegration," and it can be used to attach implants directly to bones.

9. **Robotic Exoskeletons:** Updates to robotic exoskeletons changed lives this year and redefined what's possible for patients with spinal injuries. Thanks to advances in the technology – like ReWalk's new lightweight design, higher performing straps, and more economical models –paralyzed individuals can stand, move, and walk for the first time in decades. And as a result of recent drops in cost, exoskeleton technology took remarkable steps toward becoming truly ubiquitous.

10. **Meaningful Data Collection:** More information-collecting will help monitor and prevent medical conditions and will optimize medical training in the coming decades. When large amounts of vital information are digital and accessible for machine analysis, all parties involved in healthcare system (i.e., patients, clinicians, trainees, researchers, policymakers, and stakeholders) collectively use data to enhance the care for individual patients and population health. Patients are empowered to take responsibility for own health and care. Assessment, diagnosis, and management increasingly provided by machines, resulting in improved outcomes. Healthcare providers are trained to interpret data dashboards and treatment algorithms leading to individualized care plans. A lack of real-world data, structured, longitudinal data, is currently the greatest shortcoming related to disease prevention. Governments need to assist health systems with the collection, synthesis, and distribution of this data to improve outcomes and disease research.

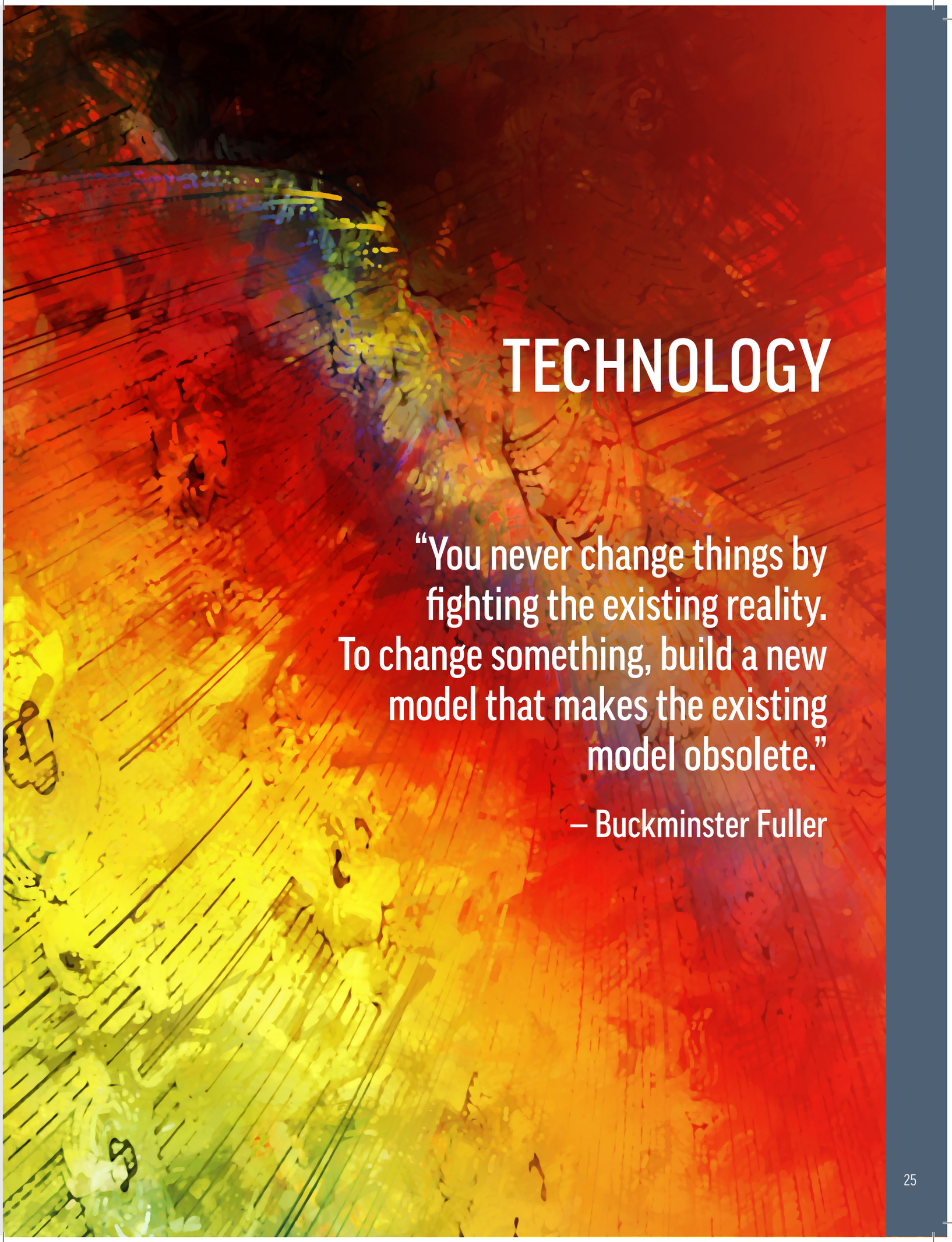
Based on the trends and driving forces you have reviewed in the domain of Health:

What will be the key changes that shape the future?

What makes you nervous (i.e. uncertainty and threats)?

What gives you hope (i.e. new opportunities)?

YOUR NOTES



TECHNOLOGY

"You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete."

– Buckminster Fuller

TRENDS IN TECHNOLOGY

Below are trends within technology that have the potential to impact future roles of pediatric physician-scientists.

1. **Artificial Intelligence, Machine Learning, Deep Learning and Cognitive Computing will increasingly be integrated into all Business Processes:** Artificial intelligence (AI) is a broad category of machine intelligence that includes powerful subcategories, such as machine learning (ML), deep learning (DL) and cognitive computing applications, and they are increasingly being offered as a service, dramatically lowering the cost and increasing the application to every industry. In addition, AI hardware is rapidly shrinking in physical size, soon to the chip level, allowing AI functionality to become increasingly embedded in products, applications and processes. Thanks to the as-a-service model, coupled with better sensors, increased machine intelligence and Alexa-like voice communications, advanced automation and intelligent networked robotics will increasingly work with humans in new and productive ways. From demand forecasting to real-time audits to the use of semiautonomous and fully autonomous vehicles, humans will increasingly rely on AI.

2. **Rapid advances in AI will drive Augmented Thinking and Augmented Movement using Exoskeleton Technologies to new levels of application:** Augmented technologies are designed to increase humans' physical and cognitive capabilities. Augmented thinking technologies will increasingly provide real-time actionable insights and knowledge drawn from AI-enabled data analytics of large data sets to enhance human thinking and problem-solving. Humans and AI will increasingly have a symbiotic relationship in which one needs the other for peak performance. Augmented movement technologies enhance physical human functionality. A hearing aid is an example of sensory augmentation; an artificial leg is an appendage augmentation, and a 95-pound nurse in Japan wearing a powered exoskeleton so that she can lift a 200-pound patient into a bed is a functional augmentation. GM workers wear powered exoskeletons to lessen arm, hand and joint problems while assembling cars. All of our physical parts and systems, including our genes, can be augmented.

3. **Rapid convergence of the Internet of Things (IoT) combined with Edge Computing, AI and 5G will accelerate, forming the Internet of Everything (IoE):** Machine-to-Machine (M2M) communications using chips, microsensors, and both wired and wireless networks will join networked sensors to create a rapidly growing IoT, sharing real-time data, performing diagnostics and making virtual repairs, all without human intervention. There are well over 50 billion "things" talking to each other, performing tasks and making decisions based on predefined guidelines using AI. With our homes, businesses, parking meters, bridges and even our bodies, through wearables, all getting connected and the possibility to link to our EHR-deposited information, the rapid growth of IoT brings us to the Internet of Everything (IoE). Not all generated data needs to come back to the mother ship to create high value. Edge computing will increasingly be used to tame the massive amounts of data IoT and IoE will create by bringing instant insights and actions to the point of use and at the speed of need. As AI increasingly becomes embedded at the chip level, the power and speed of Edge computing will dramatically increase.

4. **Social Robotics:** Whether robots continue to manifest as commonplace devices that blend into our routines, or become so life-like that no one can tell the difference between humans and humanoids, there is little doubt that they will radically change how we learn, work, create, relate to one another and even perceive what it means to be human. The term "robot" may conjure mental images of futuristic humanoids that help or hurt humanity. Beyond the popular conversations that envision robots as our teachers, caregivers and even sexual partners, they are now being leveraged to socially engineer dormant emotions and values in their carbon-based creators. For instance, the Kirobo Mini was designed to emulate a baby in hopes that it would encourage Japanese families to procreate. A similar example is the Paro therapeutic robot, which cares for elderly people with dementia and Alzheimer's. In 2017, the European Parliament passed a draft calling for a set of regulations that would grant "electronic personhood" for the most capable robots and AI. Once we have fully integrated robots into our everyday lives and elevated them to the status of "mechanical species," it follows that robots could then naturally fill all the roles that constitute the modern definition of a "job." This would free humans to live with greater passion-oriented purpose and help us to enhance the mental skills needed to be exponentially more creative, anticipatory, and transformational.

5. **Mobilization/Humanization of Robots:** One of the primary challenges with bigger robots is making them move without falling over. Balance, stability, grace – these are the things we didn't see in a humanoid robot until just this year. Boston Dynamics has been working on the Atlas robot, and new work from the Institute for Human & Machine Cognition shows that it can balance on a piece of wood as well as any person can.

6. **Transformational Invention:** We can no longer rely on iterative innovation in business or society. As organizations move past the concepts of top, bottom and lateral disruption to a more liberating and empowering mindset of transformation, they will find that the "unknowns" that once pushed them from the outside will instead become their greatest assets. An increasingly complex world demands that we move beyond incremental innovation into transformational thinking and invention in order to seize opportunities and avoid collapse. For instance, contrast the stories of two giants of the imaging technology industry. While Kodak struggled to embrace the necessary breakthrough to a new environment, Fujifilm – a distant second to Kodak in the film business at the time – began to explore new opportunities in adjacent industries. Once Fujifilm applied its knowledge around color-producing chemicals for innovation in the domain of healthcare, it began to envision its higher order purpose as a company. This led Fujifilm to leverage its vast expertise in collagen – a protein that is one of the main components of photographic film – to the field of regenerative medicine: "Leveraging the collagen technologies it originally developed for photographic film, Fujifilm has developed a recombinant peptide (RCP), an artificial protein that acts as an effective scaffold on which to grow cells." While Kodak was looking to harness digital technology as a means to supplement its business of printing pictures, Fujifilm was ascending a cascading curve of growth toward inherent but hidden opportunities.

6. **Digital Immortality:** The age-old idea of immortality is getting a 21st century reboot with digital platforms and new technologies allowing us to live forever in a cyber sense. The implications to social norms and often lagging regulations will be significant as our notions of humanity are challenged when death can be cheated with a software update. The "Right To Be Forgotten" – having autonomy over our digital identity so as to avoid perpetual consequences – has become a global issue due to its impact on freedom of expression, privacy and the integrity of Internet history. Several social media platforms want to leverage an individual's data after physical death, resulting in legislation such as the European Union's General Data Protection Regulation. Companies such as DeadSocial provide tools to prepare a social media will. Death is no longer the central issue; rather, will our digital legacies live forever? Whole Brain Emulation is the idea that we may soon be able to scan the mind of an individual and copy it to a computer. While many argue that the complexity of the brain cannot be replicated, web entrepreneur Dmitry Itskov launched the "2045 Initiative" to achieve immortality by creating an android that is capable of storing a human personality. Technologies such as blockchain and projects like the BRAIN Initiative (mapping patterns of neural activity) further the chances of successfully uploading our minds to the cloud and immortalizing our digital identities.

7. **Blockchain:** Blockchain is a distributed ledger of records and transactions that is resistant to modification. A blockchain is typically managed by a peer-to-peer network of computers, assuring that the data in any given block cannot be changed retroactively without the alteration of all subsequent blocks and agreement by the entire network. Blockchain is best known as the software behind cryptocurrencies such as Bitcoin. However, the technology has applications well beyond powering digital assets. For example, United Parcel Service (UPS) plans to use blockchain to develop the smart logistics network of the future. The biggest impact from the decentralized ledger, however, will likely be in transforming identity. Blockchain facilitates the identification process, while thwarting hackers and identity thieves. Online voting and digital governance will also benefit from the trust-enabling technology. Blockchain is already being used to transform financial transactions, but its disruptive capability will truly be felt when peer-to-peer networks are empowered to eliminate all outside influences. San Francisco-based company Bee Token is aiming to be the AirBnB of blockchain. Hosts on the platform would not pay fees to rent out rooms, and the company hopes to create a fully automated system with smart contracts. Similarly, Lino is planning to take on YouTube by creating a collectively-owned video content distribution system.

8. **Artificially Intelligent Systems to Diagnose Disease:** IBM's artificial intelligence system, Watson, saved the life of a Japanese woman by correctly identifying her disease. For some time, her illness went undiagnosed using conventional methods, and doctors were stumped. Watson looked at the woman's genetic information and compared it to 20 million clinical oncology studies. After doing so, it determined that the patient had an exceedingly rare form of leukemia. The AI's positive identification allowed doctors to develop a treatment for the woman in question, ultimately saving her life. The AI can review huge numbers of records and medical images far faster than humans can, and they are less subject to errors. To that end, experts agree that one of the greatest areas of potential for AI is in support of healthcare professionals. Satoru Miyano, a professor at the University of Tokyo's Institute of Medical Science, noted the significance of Watson's work: "Watson's solid detection and treatment solution to this is a proof that the AI is really changing the world." Seiji Yamada, professor at the National Institute of Informatics and chairman of the Japanese Society for Artificial Intelligence, added, "This is the first time in the history of the

nation when an AI system has saved a human life." He also said that "in the field of the medical and healthcare, this is the most practical application for artificial intelligence." We saw similar advances in AI in other nations. For example, in the United States, AI is in use to support treatment procedures for leukemia and brain tumors.

9. **Quantum Computing:** Recently, researchers created the first fully programmable and reprogrammable quantum computer in the world. Up until that point, quantum computers could only run one type of operation. This was the first platform that had the ability to have new algorithms programmed into its system. The reprogrammable quantum computer is made of just five ytterbium atoms standing as quantum bits (or qubits) of information, which are electrically charged in a magnetic field. The coming dawn of the quantum computer has brought with it fear, but this year, China launched the world's first quantum satellite, which was designed to demonstrate a series of advanced technologies, such as hacker-proof communications. A quantum computer could theoretically be powerful enough to crack every encryption method currently in use. The solution would be quantum networks (networks that rely on the fragile quantum state). Any attempt to copy, clone, or even measure the quantum state of a particle would result in a change in that state, erasing the information in the process. This technological advance is thought to be the key to a global quantum network.

10. **Perfecting Our Bodies Through Artificial Intelligence:** The U.S. Olympic Cycling Team trained for the Rio Olympics with the help of Solos Smart Cycling Glasses. These augmented reality glasses display important information, such as speed, heart rate, calories burned, distance traveled, maps, race time compared to previous rides, and other key information points.

Based on the trends and driving forces you have reviewed in the domain of Technology:

What will be the key changes that shape the future?

What makes you nervous (i.e., uncertainty and threats)?

What gives you hope (i.e., new opportunities)?

YOUR NOTES

NOTES

APPENDIX

FUTURIST DOCUMENTS

Trends were selected and compiled from comprehensive futurist documents below.

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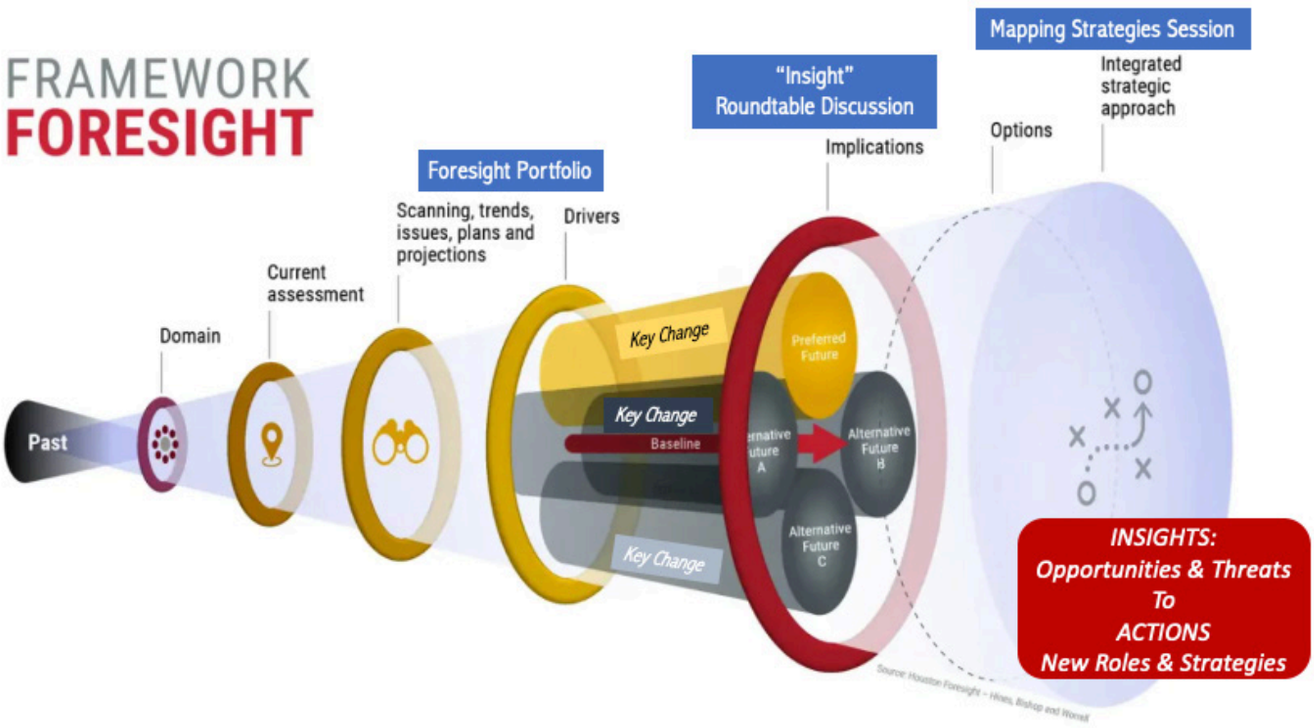
Roundtable Discussion Worksheet



Modified form Hines, A. and Bishop, P. (2013). "Framework Foresight: Exploring futures the Houston way," Futures, 51, 31-49.
Hines A (2020), "Evolution of framework foresight", Foresight, Published online 26 June 2020. https://doi.org/10.1108/FS-03-2020-0018

Strategic Foresight is a genre of methodologies that provides a framework for sense-making of data generated by structured processes to identify both trends and driving forces. Appreciating trends and driving forces will provoke insights to map out possible futures. Sense-making of insights expands and reframes the range of strategic options that need to be taken into consideration before strategic decisions are made to shape the future.

For PAS LAB, we employ the "Framework Foresight" developed by Drs. Andy Hines and Peter Bishop at the University of Houston's Foresight program (Hines and Bishop 2013, Hines 2020). The NPSCW has prepared, through an iterative process, the "Foresight Portfolio" [pages 11-30], including curated content from various futurist summaries (i.e., trends, issues, plans and projections) in four domains: 1. Education, 2. Equity, 3. Health, and 4. Technology. Through facilitated roundtable discussion, participants will reflect and interpret foresights to envision future scenarios, then brainstorm and prioritize the key changes that will occur. Through an intuitive sense-making process, participants will realize the future implications (i.e., opportunities and threats). The insights gained are used to inform the development of strategic options.

Roundtable Discussion Worksheet

STEP ONE: Determining Key Changes	
Through your reflection and interpretation of trends and driving forces within the domain of ".....", brainstorm and prioritize the key changes that will occur (up to 3). You may list ones that you have read from the Foresight Portfolio or create your own list.	1. 2. 3.

STEP TWO: Provoking Insights: Envision yourself in the "futures", influenced by the key changes from Step One, and consider the following questions:

What are the implications (potential opportunities & threats*) of the futures for physician-scientists?

What are characteristics (i.e., job roles) of the physician-scientists who will best be able to take advantage of the new opportunities?

How will the physician-scientists who face the potential threats adapt their "job roles" to thrive in the futures?

*Opportunities and threats may pertain to several factors including, but not limited to, financial, medical, governmental, security, and cultural Impacts

FORESIGHT GAP IDENTIFICATION QUESTIONNAIRE

The self-reflection tool has been created to diagnose your organization's "future-fitness." Reflection and analysis of these questions with leadership will further reveal the strength of your organization's foresight efforts and can act as the needs assessment for using strategic foresight in your organization.

Modified from the Strategic Foresight Primer: Unlock The Futurist Mindset, Futureschool.com

1. **How aware are we of the threats and opportunities outside of our healthcare organization and industry? Do we regularly identify and analyze the impact of a wide range of trends?**

2. **Do we regularly ask, "What's next for healthcare and industry?"**

3. **Are we early adopters of new trends that could transform our company, or do we like to wait until an idea has gone mainstream before we try it out?**

4. **Are we threatened by ideas that challenge our company's position on issues or actions?**

5. When we hear the words change or disruption at work, does it make our leadership feel excited or nervous?

6. Do we promote an innovative and entrepreneurial culture across our organization?

7. How much of our organizational language or communication is future-focused? Can we identify five future-focused words that we use on a regular basis in meetings or company memos?

8. How quickly are we able to adapt to new situations and changing environments?

Continued >>>

9. **Do we immediately attempt to simplify complex situations, or do we consider how they might reframe or redefine our organization's strategy?**

10. **Do we seek out opportunities to broaden our strategic and organizational horizons through diverse training, conferences, and networks?**

11. **Is our five-year plan purely based on financial projections, or does it integrate qualitative metrics such as social, technological, and policy trends?**

NOTES

NOTES

NPSCW

NATIONAL **PEDIATRICIAN-SCIENTIST**
COLLABORATIVE WORKGROUP

“THE FUTURE DEPENDS ON WHAT YOU DO TODAY.”

– MAHATMA GANDHI