

Why Operations Research / Management Science is the BEST! - A Personal Journey and Your Career Path

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Minority Issues Forum
Undergraduate Underrepresented Minorities (URM) Workshop
October 15, 2022, Indianapolis, Indiana

Many thanks to Professor Trilce Encarnación of the University of Missouri - St. Louis and to Professor Rubén Proaño of the Rochester Institute of Technology for organizing this interesting workshop and for bringing us all together!



Outline of This Presentation

- ▶ **On Being an Operations Researcher**
- ▶ **The Importance of Role Models**
- ▶ **Places that OR May Take You**
- ▶ **Your Undergraduate Journey and Beyond**
- ▶ **There Will Be Challenges – Overcoming Them**
- ▶ **Lifelong Learning**
- ▶ **Making a Positive Impact**

On Being an Operations Researcher

On Being an Operations Researcher

Conducting research and teaching are a passion and no two days are ever alike!

Everyone should have an opportunity to explore science and to become a scientist to explore our beautiful world and to add to knowledge discovery.



Intellectual curiosity and creativity underly what we do. We care about making a positive impact on our world.

On Being an Operations Researcher

I use mathematics and tools of operations research (OR) to enhance our understanding of network systems in which humans interact with infrastructure.



For the Love of **Operations Research (OR)** and **Networks**

From my first course at Brown University on the subject to my first projects in industry - working on naval submarines in Newport, Rhode Island, I was drawn to the power of networks, especially when combined with computing.



I spoke at the Naval Academy in Cartagena, Colombia in August 2019



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Off to Grad School for a PhD

While working in high tech defense consulting I very soon I realized that I did not like having a boss! I commuted, ran marathons, and worked full time while taking courses for my Master's at Brown!

Dr. Stella Dafermos was the only female professor at the time in either Engineering or Applied Mathematics at Brown University. I became her first PhD student.

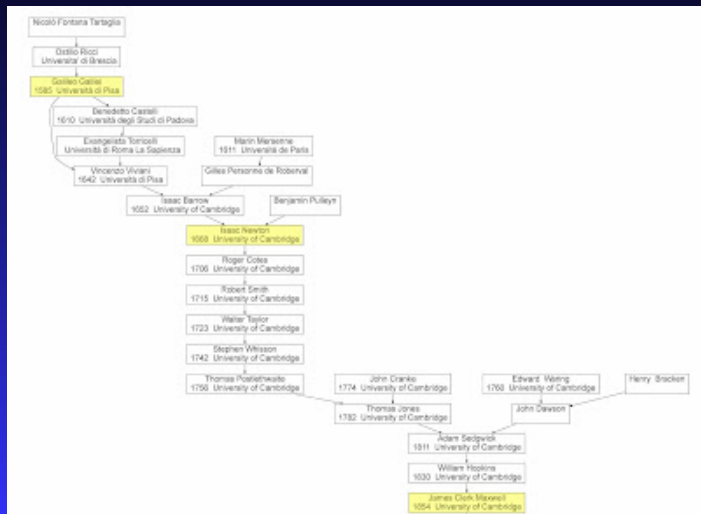


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On the Shoulders of Giants - My Academic Genealogy - **Maxwell, Newton, and Galileo**



Our Fabulous **Scientific** Community



After I received my PhD, I met **Professor George Dantzig of Stanford University**, the developer of the simplex method and a Father of OR! He came to the first presentation that I ever gave at a conference, post PhD, and it was at the Mathematical Programming Symposium at MIT.

Advising PhD Students

When I was a junior faculty member I asked Dr. Alexander Rinnooy Kan what advice he had for me and he said, “build your network and do this by graduating PhD students.” That advice resonated and has stayed with me. I have had the honor and pleasure of chairing 24 doctoral dissertations at UMass Amherst. Many of my former doctoral students continue our collaborations as Center Associates.



Inclusion of Undergraduates

- ▶ **Multiple undergraduates have taken part in research at the Center.**
- ▶ **Several of these went on to receive 21st Century Leaders Awards from UMass Amherst at graduations, an award that I nominated them for.**
- ▶ **Two OIM undergraduates, Emilio Alvarez-Flores and Karen Li, who also received a 21st Century Leaders Award, have worked with Supernetwork Center Associates and have written theses and have had journal articles published.**

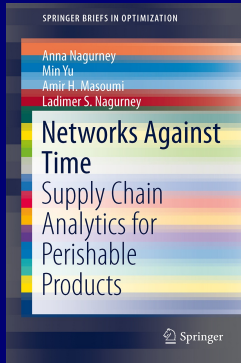


Supply Chains Are One of the Most Important Applications of OR



A Multidisciplinary Approach to Supply Chain Networks

In our research on perishable and time-sensitive product supply chains, we utilize results from physics, chemistry, biology, and medicine in order to capture the perishability of various products over time.



- ▶ **food**
- ▶ **blood**
- ▶ **medical nucleotides**
- ▶ **pharmaceuticals**
- ▶ **vaccines.**

Supply Chains Are One of the Most Important Applications of OR

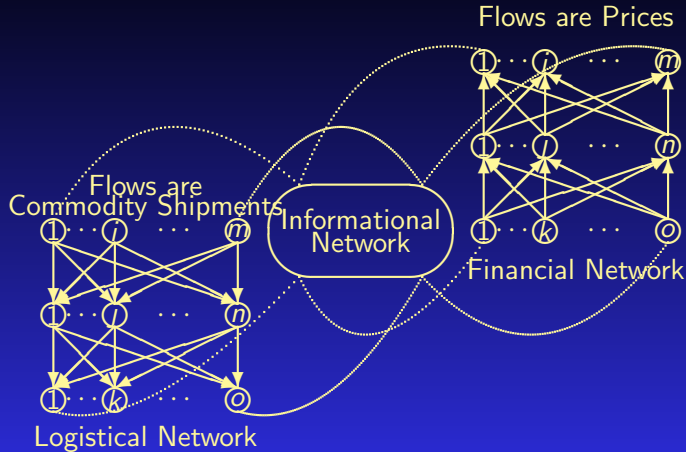
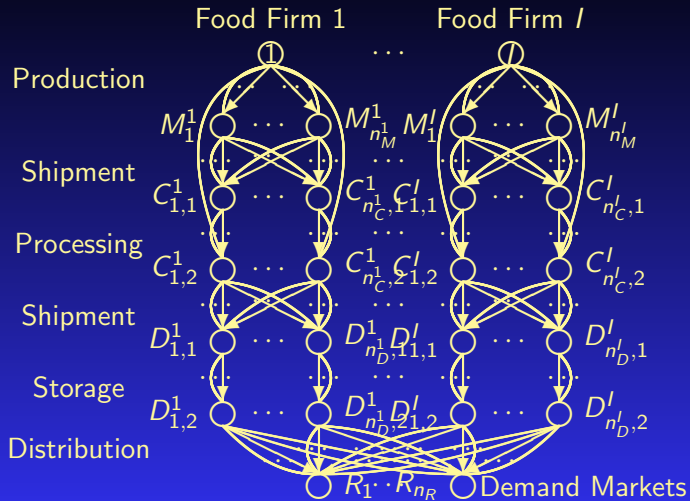


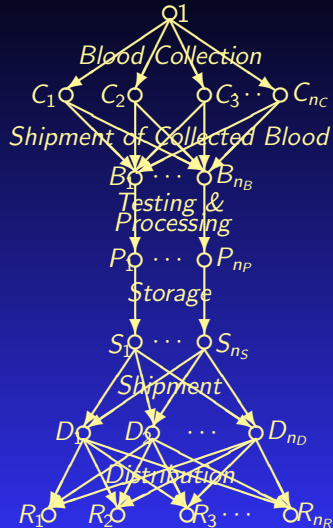
Figure 1: Multilevel Network Structure of the Supply Chain System

Fresh Produce Food Supply Chains



The Fresh Produce Supply Chain Network Topology

Supply Chain Network Topology for a Regional Blood Bank



ARC Regional Division

Blood Collection Sites

Blood Centers

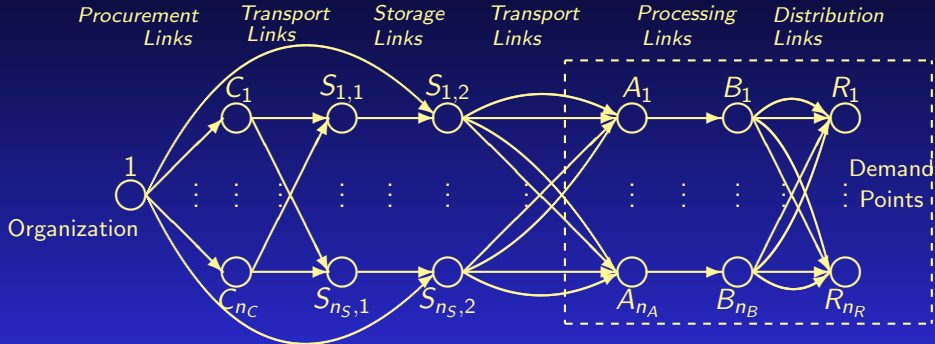
Component Labs

Storage Facilities

Distribution Centers

Demand Points

Disaster Relief Supply Chains



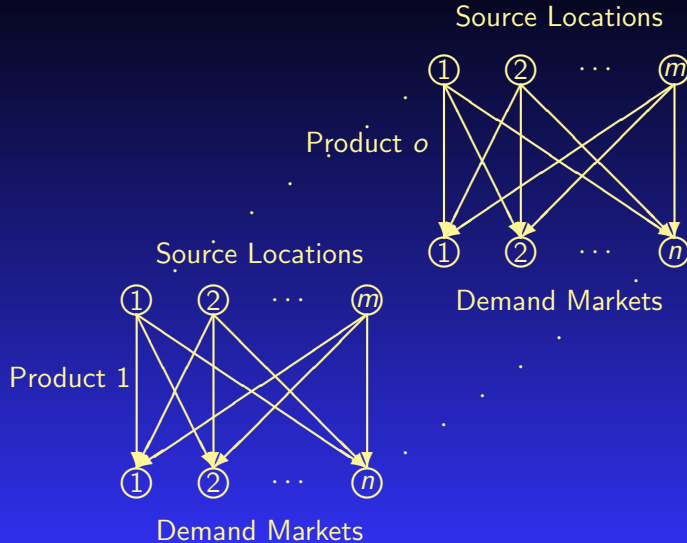
Network Topology of the Integrated Disaster Relief Supply Chain

Network Models for Cybercrime and Cybersecurity Investments



Supply chains are also vulnerable to cyberattacks and can serve as entre points.

Network Models for Cybercrime and Cybersecurity Investments



Books



It's All About People

A major research theme of ours in the COVID-19 pandemic is the inclusion of labor in supply chains, using optimization and game theory.

ORMS TODAY **informs**
membership magazine

NEWS FEATURES PODCASTS

January 29, 2021 in Supply Chain Networks

In the End, It's All About People

COVID-19 vaccine production reveals dependency on supply chains, labor workforce in the U.S.

By Anna Nagurney

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PRINT ARTICLE 

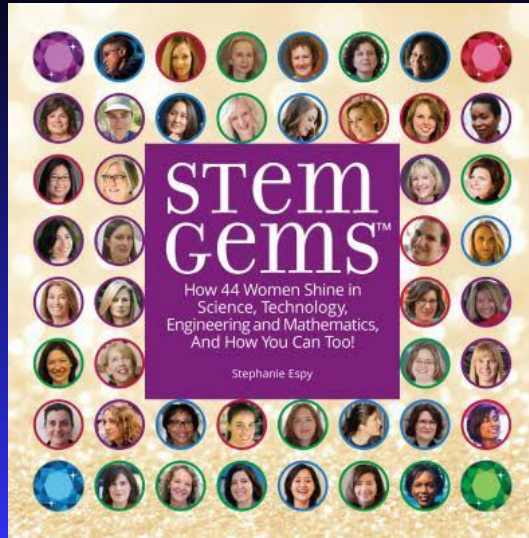
<https://doi.org/10.1287/orms.2021.01.17>



The COVID-19 pandemic has dramatically revealed how dependent we are on supply chains and the availability of labor. Without the human element, meatpacking plants cannot function; fresh produce cannot be picked; grocery stores cannot be shelled; PPEs cannot be produced and distributed; and products cannot be delivered to our homes through e-commerce. Also, COVID-19 vaccine production may lack the human resources to ensure product quality and efficacy, as well as its distribution and ultimate administration into our arms. Without healthcare workers to administer COVID-19 vaccines, the battle against the coronavirus cannot be won. Many hospitals are already short-staffed because of the pandemic.

The Importance of Role Models

The Importance of Role Models



The Importance of Role Models



Mathematics

- ◆ ANNA NAGURNEY: *Network Systems Mathematician*
- ◆ BRYNA KRA: *Dynamical Systems Mathematician*
- ◆ DEBBIE LAWRENCE: *Geophysicist*
- ◆ JEANNE GANG: *Architect*
- ◆ MARIA CHUDNOVSKY: *Graph Theory Mathematician*
- ◆ MELANIE MATCHETT WOOD: *Number Theory Mathematician*
- ◆ RACHEL SCHUTT: *Data Scientist*
- ◆ STACY LINDBORG: *Biostatistician*
- ◆ STEFANI WILDHABER: *Urban Planner and Designer*
- ◆ SUSAN ATHEY: *Economist*
- ◆ TONYA MANNING: *Actuary*
- ◆ TRACHETTE JACKSON: *Cancer Modeling Mathematician*

stem gems™



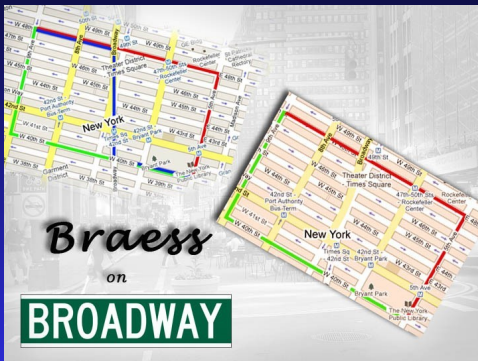
— JOIN THE MOVEMENT —

Places that OR May Take You

Places that OR May Take You



Interview on Broadway in NYC for *America Revealed* PBS TV show on March 15, 2011



Places that OR May Take You

Yalta, Ukraine with my taxi driver Igor



Buenos Aires, Argentina and the Blue Lagoon in Reykjavik, Iceland



Places that OR May Take You

Italy and Switzerland



Oxford University and Imperial College



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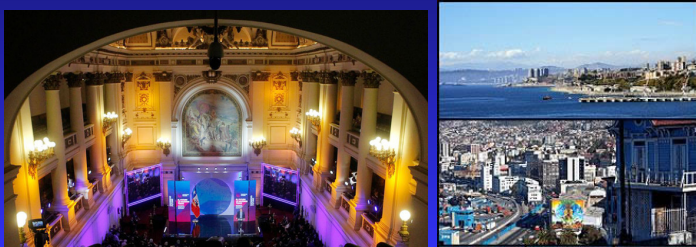
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Places that OR May Take You

Radcliffe Institute for Advanced Study at Harvard University



Congreso Futuro, Chile!



Your Undergraduate Journey and Beyond

Your Undergraduate Journey and Beyond

You may be wondering - What kind of prerequisites should you have if you are interested in an OR/MS graduate degree or a position in industry?

Your Undergraduate Journey and Beyond - Industry or Government

Because of the demand for skills that operations researchers and management scientists have, one may be able to get a job in industry directly after receipt of an undergraduate degree.

Of course, having had an internship can help!

Your Undergraduate Journey and Beyond - Industry or Government

- When it comes to positions in industry or in government, technical skills are prized as well as soft skills of communications, teamwork, etc.
- Having had multiple courses in mathematics (calculus, linear algebra, differential equations), and also a computing course (one or more), can give you a competitive advantage. Courses in optimization, math modeling, algorithms, probability and statistics, data science/analytics, are highly desirable.

Your Undergraduate Journey and Beyond - Industry or Government

- **Having domain knowledge attained from coursework may help you to identify the type of job in industry or government that you would most enjoy.**
- **Are you interested in consulting, working for a “name” company, or would you prefer working in a healthcare setting or for a logistics company or an NGO? Do you have location preferences?**

Your Undergraduate Journey and Beyond - Industry or Government

- In industry, you may receive additional training for the kind of tasks that you would be performing.

• Data Analyst			
• Risk Assurance Specialist			
• Demand Planner			
• Operations Analyst			
• Project Manager			
• Marketing Analyst			
• Financial Analyst			
• Allocation Analyst			
• Merchandise Planner			
• Supply Chain Analyst			
• Management Consultant			
• Operations Manager			
• Material Planner			
• Purchasing Manager			
• Allocation Specialist			
• IT Analyst			
• Risk Advisory Specialist			

Your Undergraduate Journey and Beyond - Industry or Government

Some of my former students have secured jobs at: Mass General - Brigham and Women's Hospital, Ford, Fedex, UPS, Kuehne Logistics, Flexport, Space X, Zipline, IBM, GE, Frito Lay, Pepsi, SAS, major financial service firms (because they had excellent toolkits).

Your Undergraduate Journey and Beyond - Grad School

If you are interested in OR/MS there are many exciting options in terms of graduate programs, from the Master's level through the PhD!

Options include: Departments in Engineering schools, in Business schools, Mathematics and/or OR departments.

Selecting a program for a Master's can entail different criteria than for a PhD.

- **Some companies will pay for you to get a graduate degree - typically, a Master's!**

Your Undergraduate Journey and Beyond - Grad School

PhD programs are, typically, more selective than Master's degree programs. If you decide to go the PhD route, selecting the right advisor (dissertation) is very important since you would be working with her/him over several years.

PhD programs in Engineering and Math departments would have slightly different criteria in selecting their students than those in Business School departments. Of course, funding and support are also what one should inquire about.

There Will be Challenges - Overcoming Them

There Will Be Challenges

At times, you may be the only underrepresented minority in the room. As difficult as this may be, you might also have an advantage, since others may recognize you and learn your name sooner than later!

Remember, that in OR/MS, you are always part of a broader community, including the Minority Issues Forum, and such communities can provide a HUGE amount of support, both in person and virtually.

Being a Part of a Community Can Help in Overcoming Challenges

I have to emphasize the importance of networking and how INFORMS can help you to expand your network at different stages of your career(s)!



**How Do I Build
a Professional
Network with the
Help of INFORMS?**

Anna Nagurney, University
of Massachusetts Amherst



Lifelong Learning

Taking Part in Conferences is Important



Celebrating Successes

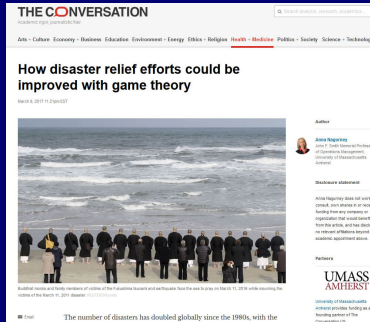


Work Life Balance

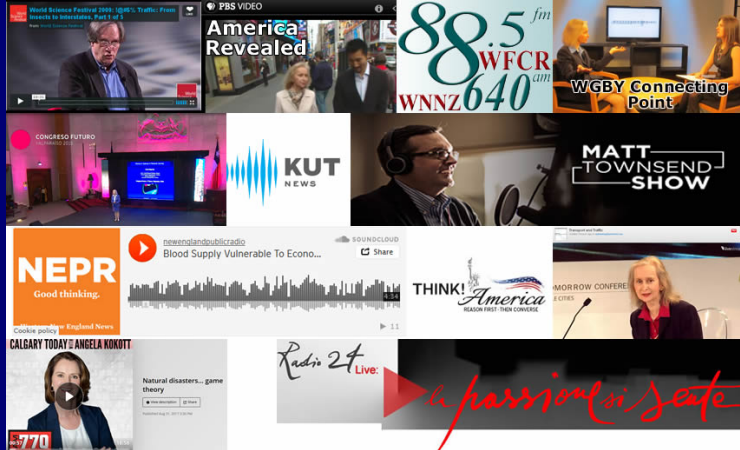
- **First**, I became a Full Professor;
- **then**, I had a child,
- **and only then** did I get my driver's license!



Making a Positive Impact



Coverage by the Media




Writing OpEds in the Pandemic

On March 11, 2020 the WHO declared the pandemic. On March 12 my article on blood supply chains in *The Conversation* appeared and, on March 24 my article in *INFORMS Analytics Coronavirus Chronicles*.

THE CONVERSATION
Academic rigor, journalistic flair

How coronavirus is upsetting the blood supply chain

March 12, 2020 8:00am EDT



The coronavirus, which causes the disease COVID-19, has created enormous anxiety, uncertainty, and disruption to our lives. Much has already been written about potential shortages of medicines and face masks, but little has been said about something only you and I can provide – lifesaving blood.

Our nation's blood supply is essential to our health care security. Blood transfusions are integral parts of major surgeries. Blood is used in the treatment of diseases, particularly sickle cell anemia and some cancers. Blood is needed for victims who have injuries caused by accidents or natural disasters. Every day, the U.S. needs 36,000 units of red blood cells, 7,000 units of platelets, and 10,000 units of plasma.

Share: 26 | 1.5k

Anna Nagurny


Analytics
ON THE BATTLEFIELD OF BUSINESS DECISIONS

March 24, 2020 in Coronavirus Chronicles

The COVID-19 Pandemic and the Stressed Blood Supply Chain

By Anna Nagurny

SHARE: [f](#) [in](#) [t](#) [v](#) [p](#) PRINT ARTICLE: [p](#) <https://doi.org/10.1287/LYTX.2020.02.18>



Blood is essential to our nation's healthcare security. It is a life-saving product that cannot be manufactured and comes solely from volunteer donors. No substitute for blood has yet been invented. Blood transfusions are integral parts of major surgeries. Blood is a must for saving victims of accidents and natural disasters. Blood is also used in the treatment of certain diseases, including certain cancers. In the United States, 36,000 units of red blood cells are needed daily as are 7,000 units of platelets and 10,000 units of plasma. A typical donation of one pint, which can be divided into red blood cells, plasma and platelets, can save up to three lives. Adults have 8-12 pints of blood.

Even in the best of times, the complex blood supply chain in the United States is under stress. Although 38% of the U.S. population is eligible to donate blood, less than 10% actually does so in a year. Furthermore, issues of seasonality come into play with flu and colds cutting donations; the same for weather-related events and holidays. To further complicate matters, blood is perishable; platelets last five days and red blood cells have a shelf life of 42 days.

The blood banking industry, entrusted with maintaining a sufficient supply of blood, is facing a battle of the century with the COVID-19 pandemic. The timing could not be worse with this year's heavy flu and cold season, and the

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Writing OpEds in the Pandemic

On August 4, 2020, I published an article in *The Conversation*,

“The Raging Competition for Medical Supplies is not a Game, but Game Theory Can Help.”



Writing OpEds in the Pandemic

On September 18, 2020, I published another article in *The Conversation*,

“Keeping Coronavirus Vaccines at Subzero Temperatures During Distribution Will Be Hard, but Likely Key to Ending Pandemic.”

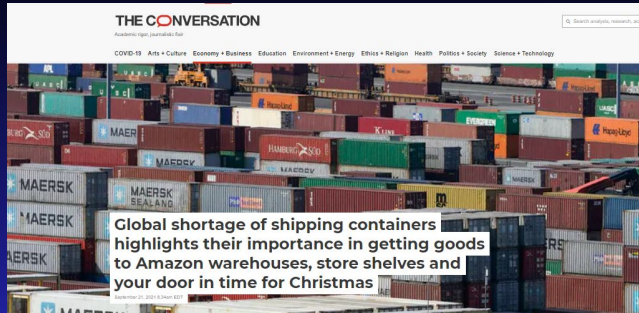
Writing OpEds in the Pandemic



On April 5, 2021, I published the article,

“Today’s Global Economy Runs on Standardized Containers, as the Ever Given Fiasco Illustrates,” also in *The Conversation*.

Writing OpEds in the Pandemic



On September 21, 2021, my article,

“Global Shortage of Shipping Containers Highlights Their Importance in Getting Goods to Amazon Warehouses, Store Shelves and Your Door in Time for Christmas,” appeared in *The Conversation*. It has had over 330,000 reads.

Writing OpEds in the Pandemic

On February 3, 2022, my article,

“Heading into the Third Year of the Pandemic, the US Blood Supply is at a 10-Year Low,” was published in *The Conversation*.



Some of My Media Interviews in the Pandemic



Some of the Media Interviews on the War on Ukraine

Economic dangers from Russia's invasion ripple across globe

By PAUL WISEMAN and DAVID McHUGH March 2, 2022



Feedstuffs went live.
March 16 at 2:00 p.m.

The war in Ukraine is no longer just a story about a conflict between nations. It's having an immedi...

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Anna Nagurney with John Moore



The John Batchelor Show

1/2: #Ukraine: The Kyiv School of Economics is open for business under fire. Paul Gregory @HooverInst @PaulR_Gregory. Anna Nagurney @Supernetworks, University of Massachusetts. Paul Becker, Duke University

Russian war in world's 'breadbasket' threatens food supply

By JOSEPH WILSON, SAMY MAGDY, AYA BATRAWY and CHINEDU ASADU March 6, 2022

'I fear a cultural genocide'; Ukrainians in Western Mass. watch, worry and help

Published: Feb. 28, 2022, 5:55 p.m.



Threat of Russian cyber attacks likely for not just Ukraine, but also in the US

No Ikea Shelves, No Levis: The Retail Exodus From Russia Is On

Since the invasion of Ukraine began, the increasing financial and reputational risks of doing business in Russia are leading Western brands to halt operations.

Russian Sanctions Snarl Shipping Even as Pandemic Pressure Eases



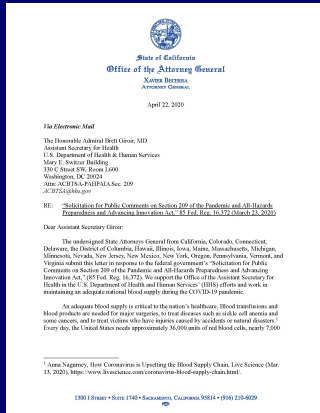
March 11, 2022
Liz Alderman and Jerry Gross

Impacting Policy

On April 22, 2020, a letter from California Attorney General Xavier Becerra to the Admiral Brett Giroir, the Assistant Secretary of the US Department of Health & Human Services, and signed by US Attorney Generals of 21 other states, requested updates, because of the pandemic blood shortages, to blood donation policies that discriminate.

My March 2020 article in *The Conversation*, which was reprinted in LiveScience, was the first reference and was cited on the first page.

Impacting Policy



Xavier Becerra, then CA Attorney General, is now Secretary of Health and Human Services!

Anna Nagurny

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It's All About People!



Thank you very much! Best of Luck and stay in touch!