Full Interview with INFORMS HAS President, Dr. Pengyi Shi

The INFORMS HAS student liaison team spoke with Dr. Pengyi Shi, Associate Professor in the Daniels School of Business at Purdue University and current President of INFORMS HAS. In this interview, Dr. Shi discusses her path into healthcare operations, the role of interdisciplinary training in her research, the challenges and rewards of translating analytical tools into practice, her vision for HAS, and her advice for PhD students navigating an AI-enabled research landscape.

Opening and Personal Introduction

Could you briefly introduce yourself to the HAS community, including your current role and professional background?

I am Pengyi Shi, an associate professor in the Daniels School of Business at Purdue University. I received my PhD from Industrial and Systems Engineering at Georgia Tech in 2014.

My research is in healthcare operations. I use stochastic modeling, artificial intelligence, and machine learning to improve healthcare. Much of my earlier work focused on patient flow, while my more recent work has expanded into areas, including substance use treatment, criminal justice, and home-based care for elderly patients.

Academic Journey and Professional Path

Your academic background spans applied mathematics, economics, industrial engineering, and statistics. How has this interdisciplinary path shaped the way you approach research problems today?

I have always had a strong passion for using mathematical tools to solve practical problems, and that was one of the reasons I initially switched my major. My undergraduate training was mainly in applied mathematics and computational mathematics. Many of my classmates who planned to pursue PhD programs were considering applied mathematics, statistics, or related fields.

In my senior year, I realized that I did not want to focus only on mathematical or theoretical work. I wanted to find a field that would allow me to use mathematical tools and modeling to solve real-world problems. That was how I found industrial engineering. This was around 2007. At that time in China, industrial engineering was not a very well-known field. I was fortunate that, through a random connection, someone introduced the major to me. It sounded very close to what I wanted to do. When I began exploring PhD programs, I realized that industrial engineering was the direction I wanted to pursue.

At Georgia Tech, I was fortunate to have two advisors. One was very theoretical and worked in applied probability. The other was more practice-oriented. From one advisor, I learned rigor; from the other, I learned how to talk to practitioners and identify interesting, practically relevant questions. I think that combination really came together in shaping the way I do research.

Having already gone through the experience of changing fields, I developed the mindset that when I want to solve a problem, I should be open-minded about the tools I use. During my PhD, I took a statistics course and really enjoyed it, so I decided to pursue a minor in statistics. That training later helped me when I began exploring machine learning and AI, because it gave me a strong foundation.

What led you to focus specifically on healthcare applications, and how has your view of research impact evolved over time?

My interest in healthcare goes back to my college years. During my first week of college, I broke my arm. At first, I thought it was a minor injury. It happened by accident in the evening, and my mother was with me because it was the first week of college. We went to the emergency department at a local hospital in Beijing.

The doctor took an X-ray, and unfortunately, the injury turned out to be more serious than a fracture. They found that I had a bone tumor. I was scared and in a lot of pain. However, the hospital was so crowded that there was no way for me to be admitted, so they sent me back to the hotel where my mother was staying. I was experiencing severe pain, but I could not get a hospital bed. The next day, I returned to the hospital for an MRI and CT scan. It became clear that the situation was more severe than anyone had expected, and I needed surgery the following day. Again, there was no bed available, so I was admitted but slept in the hallway that evening. Even now, I can still remember that experience vividly.

That experience became a strong motivation for me. I felt that there was clearly something happening in the healthcare system, and I wondered whether there was a way to address it. At that time, I did not yet know that industrial engineering could provide the right tools. Later, when I was exploring PhD programs, I realized that industrial engineering might allow me to study and improve healthcare systems. That was how I started doing healthcare research.

Looking back, what experiences in the early stages of your career were most formative for you?

There were many formative moments. In my first two years, I took many mathematically demanding classes. It was very hard. At one point, I was losing confidence and asking myself whether I could complete a PhD. There was one semester when I was almost crying every week because I could not finish the homework. It was simply very difficult.

Both of my advisors were very supportive. They told me that this was building my foundation and that, once I got through that barrier, I would have more tools to solve the questions I wanted to solve in practice. I think that support helped me get through that time. That struggle really laid a good foundation for my whole career up to now. Even though I am not doing super theoretical research, I can apply those tools properly to practical questions.

As an early-career faculty member, I also had another transformative experience. In my third-year review, I got a warning that I might fail tenure. I was very frustrated, because I was slow in building up my research. I was talking to hospitals and trying to build connections, but building those connections by yourself as an early-career faculty member is not easy.

I also made a difficult choice. I could either continue to publish more theory-driven queueing papers, which would require less setup and potentially get me to publication faster, or I could choose the route I ended up choosing, which was to address questions I was passionate about. I did not want to publish just because I had to publish to get tenure.

At that time, I talked to many different people, including my two advisors, who still cared about me and supported me. I even asked them whether I should quit. They were super supportive. I was also fortunate to have many peers at a similar stage who gave me encouragement and advice.

I also talked to a few senior faculty. They told me that what I was going through was a normal period. They said that, yes, I might be a little slower than my peers, but if I could successfully get through that struggle, I would have a much more enjoyable career later. I remember one senior faculty member told me that the first three to four years are really hard, but if you do what you like and follow your passion, the rest of your academic career can be very rewarding. The most important thing about an academic career is the freedom to choose what you want.

I think that encouragement kept me going. I gave it another serious try for another year, and somehow during that year I made a breakthrough in how to do research and how to write papers. After that, things got easier and easier. So I think the third year was really the most challenging part for early-career faculty.

Research Themes and Real-World Impact

Of all the projects you have worked on, is there one project that stands out as the most exciting, and what made that experience so special?

Looking back, there has been one project at each stage of my career that felt especially exciting.

Before tenure, the most important and exciting project I worked on was eventually published in *Operations Research* and won several awards. It was one of my first projects where I had real independence. I used stochastic optimization, queueing, and prediction to solve a discharge management problem. From formulating the question to solving it and then seeing part of the work implemented in a hospital, the project helped me understand the full process of addressing a realistic healthcare problem while still producing methodological innovation suitable for a top journal.

Around the time I was approaching tenure, another project became especially meaningful to me. I worked on it with a PhD student. In a business school, you do not have many PhD students, and junior faculty are not strongly encouraged to take on students very early. Around my fifth or sixth year on the tenure track, I began working with Xiaoquan, who is currently an assistant professor at Singapore Management University. At that time, I told her that she could either work with me on healthcare, or we could work on something completely new that could become part of her own future research identity. The timing was good. A colleague from the nursing school came to me with a problem that was not exactly in healthcare but was connected to criminal justice. She was working with local community corrections. People would go through treatment programs, but after leaving the program, they might reoffend. From a modeling perspective, the problem looked very similar to readmission. The motivating context was substance use disorder. There are many opioid-related challenges in the Midwest, and many people go through treatment programs, relapse, and reoffend. It was a system-level issue. I brought that question to Xiaoquan and her co-advisor in Purdue Biomedical Engineering, and we decided to tackle it together. One reason was that I wanted to explore a new area. Another was that I wanted to see whether I could successfully mentor a PhD student.

We went on a five-year journey. Getting the data and the connection already took one to two years. Then in the third year, we had to figure out how to solve the question, how to build the model, and how to solve it in a way that was neither too complicated nor too simplified. We spent one to one-and-a-half years struggling through what the right modeling framework and the right methodology would be. At that point, I was learning reinforcement learning, and I told Xiaoquan that it might be the right tool. We learned reinforcement learning together and then applied it successfully to the project. The outcome was very good. The collaborating community corrections agency adopted the results and used them to justify their staffing budget in one of their town hall meetings. We felt that the work was making a real impact. At the same time, my student won multiple student competition prizes. I was very proud of her. As a professor, seeing your student achieve something you did not achieve during your own PhD is a wonderful feeling. I felt that I had played a role in shaping her career. I was grateful for what my own advisors had done for me, and I felt that I could now pass that support on to my own student. She found a very good job, and our paper is currently under major revision at *Operations Research*.

My most recent proud project is the work I am doing with practitioners, nurse managers, and home care agency owners. I am now at the stage where I want them to adopt my tool more broadly. I do not want just one person to use it; I want many people to use it. I have been writing an NIH grant, and I secured participation from three hospitals, two in Indiana and one in Texas, for a feasibility pilot of an AI-enabled staffing tool. Even getting one hospital to say yes required a lot of work, so getting three was a recent proud moment.

What made that collaboration work, and were there moments when you thought the translation might not happen?

There are many ups and downs in this kind of work. The key question is why people would want to use your tool. It may look nice on paper, but how do you build trust? That is something I have been working on, particularly in recent years, because we are doing a lot of AI research.

When you talk with people in hospitals, you see that AI adoption in healthcare is growing, but not as quickly as in some other industries. A major issue is trust. Physicians sometimes publish and read academic papers, so they may understand more about how AI can augment rather than replace their work. But when you talk with nurse managers or home care agency owners, they often do not come from a data-driven or mathematically intensive background. The question is how to earn their trust and make sure they are willing to adopt your tool.

Through deployment work over the past two or three years, I have realized that you cannot begin by saying that you have a fancy mathematical AI tool or optimization tool. People may not understand or care about that framing. You need to begin by asking what their biggest pain point is and what their biggest challenge is in their daily work. That is how we found that staffing is a major issue. Nurse managers may spend five hours every day scrambling to create schedules. They do not want to sit in front of a computer all day working on scheduling. They want to manage and support their nurses. That is where we can help. We can build an AI and optimization tool that understands what they are doing and gives them a schedule in a few seconds. They can still adjust it, so the human remains in the loop, but the tool saves a tremendous amount of time.

For deployment, building trust requires understanding what bothers practitioners most. You cannot simply come in and say that you have something that will improve their lives. Why would they believe you? Even if you are a professor, they may think that you do not understand nursing or healthcare. You have to ask what their pain points are and what you can do to help. Then you connect your solution and your technology to those needs.

If you could point the HAS community toward one direction right now, what would it be?

The HAS community is already very interdisciplinary, and people are very supportive. We have members from many different backgrounds, and the community is already working on many important problems. AI is a major topic, and more people are studying how AI can be used in ways that build trust. I would not necessarily say that there is one area that is understudied. Instead, I would encourage us to join forces and put even more effort into making sure healthcare practitioners are truly using the tools we develop as a community.

HAS Leadership and Vision

What does it mean to you to serve as president of HAS at this point in your career, and what opportunities do you see for strengthening connections between students, faculty, and practitioners?

I have been involved in HAS since the beginning of my career. I started as a councilor, and then I served a two-year term in communication and outreach. I attended board meetings and organized a flash talk session for job candidates during the COVID years. That period was extremely challenging, but I made many friends and got to know other faculty and colleagues in the community. I also worked closely with the student liaisons while serving in communication and outreach. I really like this community.

After those two years, I took a one-year break because the communication and outreach role was very time-consuming. Then Tim Chan became president, and during the business meeting there was the usual call for nominations and applications for HAS leadership roles. The communication role and the vice president role were open. Since I had already served in communication and outreach, I decided to apply for vice president, which would later lead to the president role.

Essentially, I wanted to continue contributing to this society because HAS feels like my home society. That is why I applied, and now I am serving as president.

Going forward, my goal this year is to continue many existing initiatives. We are already doing many things, and you will likely see more LinkedIn posts soon. We are planning more activities to connect students, junior faculty, and senior faculty. For example, at the upcoming healthcare conference in July, HAS will organize three coffee sessions. One coffee session is for PhD students. We invited junior faculty who recently went through the job market to meet with PhD students in an informal environment, where students can ask how to prepare and what to pay attention to. The second coffee session is for early-career faculty members. We invited several faculty members who recently received tenure to share their experiences going through the tenure track. The third session is for mid-career faculty, including people at my stage or those who have recently received tenure. We invited two people, one from industry and one who recently became a full professor. I want to pair them to show that, after tenure, there is more freedom either to continue pushing publications toward promotion to full professor or to engage more deeply with industry partners.

For me, one reason I am willing to do more deployment work after tenure is that I have tenure. I no longer have the same clock ticking to publish papers. If you deploy work, there is no guarantee that it will lead to a top-journal publication. Now I have the freedom to work more closely with industry partners and do practical work on the ground. That is one way we are promoting more connection and networking across students and faculty members.

How can HAS best bring together people at different career stages, across different methods and applications?

The coffee sessions are one example. This year, we will also continue expanding our online seminar series. We now have two series. One is the regular online seminar series, and the other is the international seminar series organized by Risa.

For the international series, we are specifically focused on inviting PhD students and postdocs. We want to give them a spotlight and an opportunity to share their research, while allowing other students and faculty members to attend and provide feedback. This is one way to promote student and postdoc research and help them interact more directly with people at different career stages.

In the regular online seminar series, we are adding additional areas of focus. One upcoming seminar will specifically bring in a practitioner perspective. One professor from NYU is in the medical school, and we want to connect that practitioner perspective with the HAS community.

We will also use the online seminar series to give junior faculty more visibility. Similar to giving students the spotlight, we want to give junior faculty the opportunity to present their research to senior faculty, students, and peers at similar career stages. In that way, HAS can create more opportunities for networking, cross-stage interaction, and mutual understanding across different research areas.

Students and Mentorship

What advice would you give PhD students who are interested in healthcare applications, especially in today's landscape with AI and changing technologies?

This is something I have been thinking about a lot recently, because I am also advising students.

First, many AI tools are now available. I have been doing a lot of AI-assisted coding recently, and I think these tools are very useful for increasing productivity. I tell all of my PhD students that these tools are available, that they can increase productivity, and that students should not resist them. Some people resist using AI tools, but I encourage students to learn and use them because they can be very helpful. In that sense, AI may make the job of a PhD student harder, not easier. You can no longer spend a whole week coding and consider that the main output. Coding can be enjoyable, but it often follows an existing framework and is less central to original research. If AI saves time on coding, then you have more time to dig deeper into the research problem, develop originality, and build creative and independent thinking. That is much harder. So the bar is going to be raised.

Second, students still need to talk to people. You cannot innovate well by staying only in your office. That is the part AI cannot replace, and it will become even more important. You have to talk to the people whose problems you are trying to solve. You have to go to the ground and understand their challenges. AI can help save time by taking notes and organizing notes, but that should support more engagement, not replace it. Students should use these tools to talk with more people and better understand their challenges and pain points.

My advice to PhD students is to embrace AI tools, but do not let AI master you. You have to learn how to master AI so that it can help you do better research.

Closing

Is there any message you would like to share with the HAS community?

Healthcare is one of the most important research areas, because everyone needs to be healthy. There are more and more developments in new drugs, new healthcare delivery modes, and virtual health. Many new things are emerging, so the area is becoming increasingly exciting. I hope more people will become excited about this area and continue doing good research that advances healthcare. Let us join forces and work step by step toward improving the healthcare system.

Acknowledgment

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