

# The odds of infection

Probability theory began in an Italian town that now confronts a new virus  
BY JASON HOROWITZ

As his glasses fogged up from the mask he wore over his mouth and nose, Riccardo Rosso, a historian of mathematics, scribbled on a blackboard the possible outcomes of a dice game, substituting the chances of getting the coronavirus.

"The concept is the same," he said. "It is still probability." But he noted that many variables in the current health emergency were still unknown. So personal interactions — increasing the potential to come in contact with the virus — were probably a bad bet.

"The probability of these encounters can be minimized obviously by reducing one's social life," he said.

That is precisely Italy's strategy, on a grand scale. Having expanded an initial lockdown of 11 towns first to a northern region of 16 million people, and then to the entire nation — most recently ordering the closure of nearly all businesses except pharmacies and supermarkets — Italy is trying to reduce the chances

that its coronavirus epidemic, already the worst in Europe, will spread further.

**FACING HISTORY AS WELL AS CRISIS**

As President Trump moved to address the coronavirus crisis, history offered some lessons. **PAGE 4**

As it does, caution is mixing with hysteria, paranoia and fear. The question on almost everyone's mind: What are my **DEBT BOMB WITH A VIRAL FUSE?**

There are worries that the coronavirus could be a tipping point for companies that are loaded up with debt. **PAGE 7** chances of getting infected?

In Italy, at least, there is no better place to assess those odds than Pavia. The handsome town of about 75,000 sits south of Milan, in the middle of the hard-hit northern region of Lombardy, and is known as the Las Vegas of Italy for its abundance of slot and lotto machines.

More than that, Pavia is famed as the home of Gerolamo Cardano, a 16th-century mathematician and doctor. His father was an associate of Leonardo da Vinci, his siblings succumbed to the plague, and his terrible luck at gambling inspired him to try to divine whether the dictates of fate could be predicted and calculated.

His landmark treatise made him a father of probability theory, something the modern world seemingly takes for granted — until something terrifyingly random, like the ravages of an invisible viral predator, vaults it to the forefront of our consciousness.

In the intensive care unit of a Pavia hospital, doctors are treating a person known as Patient 1, a previously healthy 38-year-old runner who is believed to have helped spread the virus around the Lombardy region.

The hospital's doctors are busy calculating the probability of contagion, illness and death. Dr. Raffaele Bruno, **ITALY, PAGE 4**



## Italians ponder their chances as virus spreads

ITALY, FROM PAGE 1

rector of the infectious disease unit at the San Matteo Hospital in Pavia, said they were compiling a data set to help international colleagues have a better sense of the stakes.

Cardano's work contributed to the understanding that outcomes could be better estimated in a game of fixed rules and parameters, and so risks could be better assessed.

That thinking has imbued modern

life. The notion of providing an order and manipulating the odds has influenced thinking on an assortment of public health policies, including seatbelts, bike helmets and smoking bans. An assumed understanding of fixed risks contributes to myriad and subtle daily decisions as varied as the likelihood of a commuter train's derailling and the freshness of supermarket sushi.

The coronavirus destabilizes those quotidian calculations. Activities as

mundane as shopping or grabbing a drink with friends can suddenly take on calamitous dimensions.

The random-seeming nature of the virus is unsettling, but the parameters of risk also shift as it spreads, not just by



Peso:4-31%,1-14%

infecting more people and increasing the chance of contagion, but by putting so much stress on health systems that the predicability of care and recovery is no longer certain. The shortage of hospital beds and respirators enters the equation. Triage is a variable.

"You can calculate the odds when you have the numbers," said Fausto Baldanti, a virologist at the San Matteo Hospital in Pavia. "If you don't have the numbers, everything is hypothetical."

He said that the hospital's early efforts to separate coronavirus patients from others had helped bring the death rate down, as had what he called a "huge expansion of the intensive care units."

Those rigorous measures in the Lombardy region reduced the number of serious cases and deaths, he noted. Nevertheless the virus's toll in Italy has continued to rise, this week surpassing 12,000 infections and 800 deaths.

The overload of the system, he said, meant that care was not a constant.

On Wednesday, Giorgio Gori, the mayor of Bergamo, a town in Lombardy, who had written on Twitter that intensive care units had become so overloaded that "the patients who cannot be treated are left to die," said in an interview that doctors were forced to write off those with "smaller chances of survival."

Earlier in the week, a doctor in his town had posted on social media a graphic account of the stress on the health system, calling the situation an "epidemiological disaster" that had "overwhelmed" medical workers. Officials at the hospital said on Wednesday that it was close to collapse, with coronavirus patients taking up 60 of its 80 intensive care beds.

**Nino Cartabellotta**, a prominent public health researcher in Italy, said more than half of the 851 intensive care units in Lombardy were now occupied by coronavirus patients.

**The random-seeming nature of the virus is unsettling, but the parameters of risk also shift as it spreads.**

"When the system is saturated, death rates spike," he said, adding that a continuation of the current trend would cause the health care in the north, the jewel of the Italian system and equivalent to or better than that in much of Europe, to collapse. "That's why it's important that people stay at home."

The entire nation must now base behavior on interpretations of percentage points and ratios as Italians seek to reassert a modern sense of control over a virus that feels maddeningly Old World.

Still, fear and fatalism go hand in hand.

Last week, before Italy expanded its restrictions to slow the virus, a group of young women spent the evening playing cards around a small table in the center of Pavia, which is not far from the towns in the initial wave of the lockdown.

"No matter how good you are, if you get lousy cards, you lose," Giorgia Casano, 21, said after winning a hand. She said the coronavirus was more or less the same.

"No matter how many times a day you wash your hands, or how much you shut yourself at home, if you have bad luck you are going to get it," she said.

That sentiment was not limited to the young. In the historic center of Pavia, even those more at risk didn't feel so imperiled. "You've got to die of something," Cesarina Gregotti, 71, a retired medical school professor, said last week as she took a stroll after finishing a dry Martini aperitivo, which she hoped would "embalm" any trace of the virus.

Cardano's name is all over Pavia. It is on closed schools and vacant hotels and streets. His contributions to algebra and mechanics are still used today, even if some of his ideas, including doing the horoscope of Jesus, ran afoul of the Roman Catholic Church.

A portrait of Cardano, his face gaunt, hangs with other scientific standouts from the University of Pavia, including Alessandro Volta, in the medical museum. Some rooms dedicated to the school's famous anatomists and biologists had a Frankenstein's lab feel.

Outside the museum, the grounds

were empty of students, as regional officials had ordered the university, founded in 1361, closed.

Dr. Marco Benazzo, the head of the university's medical school, worried about the "exponential" growth of the virus and rushed to an emergency crisis meeting, where he said the number being thrown around for possible infections was at least 15,000.

According to Mr. Rosso, the math historian, who teaches at the University of Pavia, Cardano realized that "there was never certainty, but one can put themselves in the condition to reduce risk."

In the case of the coronavirus, he said, that translated to "taking precautions that go in the direction of improving the parameters" against contagion.

"Cardano says in the end the greatest advantage that you can have in gambling is not to play at all," Mr. Rosso said, though Cardano did not see the fun in that.

For weeks, neither did many Italians, who alternately obeyed and bridled at the restrictions imposed on them.

Gabriele Zanardi, a psychologist at the University of Pavia, said that Cardano showed that interpretation of numbers was just as important as the numbers themselves.

He said that the initial government reaction and news reports had caused a spike in personal alarm systems, but that subsequent efforts to calm nerves had created a sense of security.

"One day it seemed the plague, the next a simple flu," Mr. Zanardi said. Some people, he added, had a "psychology of invulnerability" that led them to rebel against precautions.

"They look for control on what is not controllable," he said. "It's like gambling."

