Workshop on the Economics of Antibiotics – Summary

Toulouse, December 6, 2021

CONFERENCE VENUE

Toulouse School of Economics (TSE)

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BIOMÉRIEUX

GERSGIE

leem les entreprises du médicament

Bpifrance (PIA) for the ARPEGE project

Summary

The rise of bacteria resistance to antibiotic treatment is one of the biggest challenges for health policy. Organized by Pierre Dubois, this workshop was an opportunity for academics from Europe to interact around four main questions tackled by recent economics research: how *big data* can be used to inform the best usage of antibiotics, how network effects play a role in the spread of AMR, what are the key drivers of antibiotics prescription and what can be said so far about the efficiency of policies aiming at overcoming AMR.

During the first session of the day, **Michael Ribers** from the University of Copenhagen presented his joint work with **Hannes Ullrich** on how the use of machine learning can help physician decision making in antibiotics prescriptions.

The project was motivated by a mismatch between the set of patients treated by antibiotics and the set of patients with bacterial infection: "Some patients need antibiotics and do not get it. Some do while they do not need it." In Urinary Tract Infection (UTI), only a fraction of the disease is due to a bacterial infection and require antibiotics to be cured. "There is a trade-off. Every time you prescribe antibiotics, you promote resistance but delaying treatment decision will only affect patients with bacterial infection." Physicians are already prescribing more antibiotics to people who need it but some people with very low risk of bacterial infection still get a prescription. Combining bacterial

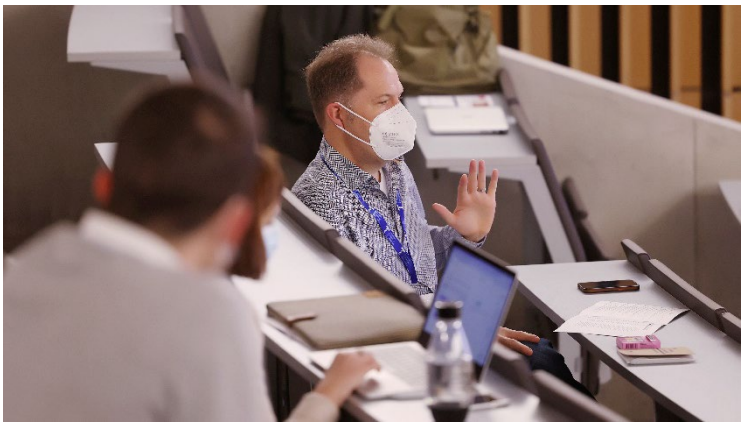
risk prediction from a machine learning algorithm with an economic modeling of treatment decision, the authors' findings suggest that redistribution towards more at risk patients could reduce antibiotics overprescribing by 23%, keeping constant overall treatment performance[1].

In terms of policy recommendations, providing patients' predicted risk to physician would improve the share of bacterial infections treated but at the expense of higher overall prescriptions. Increasing physician's sensitivity toward resistance on top of providing information on patient's risk allows to get closer to the efficient redistribution of prescription while keeping the treatment performance as good as what is observed.

The second session focused on understanding better how AMR occurs. To that end, **Jérôme Adda** from Bocconi University in Milan presented ongoing research on the role of physicians and patients flows in the spread of resistance. Using detailed hospital data on physicians and patients in Florida between 2000 and 2015, the researcher provided evidence of very dense patients and physicians networks, highlighting asymmetries between hospitals wherein key players, usually larger hospital, in denser areas, coexists with smaller, more isolated hospitals.

In this context, Jérôme Adda studies the spread of bacterial resistance from one hospital to the other when the two healthcare facilities are in the same networks. Patients' flows contribute more to the spread of resistance than physician flows. The propagation of resistance across the network depends a lot on how the hospital is integrated in the network. A one period reduction in resistance in a key healthcare facility can generate strong multiplier effects, even several periods after the shock, as the intervention will be carried through the entire network.

The goal of the next session was to understand the drivers of antibiotics prescriptions. The choice of treatment is usually made based on the physician's diagnostic after interacting with the sick patient. When the treatment involves a drug prescription, its efficacy will depend on the resistance of the bacteria to the drug, if the disease is caused by a bacterial infection, and it will contribute to further bacterial resistance in the future.



In the first part of the session, **Hannes Ullrich** from DIW Berlin and University of Copenhagen presented a joint work with **Shan Huang** measuring the effect of the physician practice style on antibiotics intakes as opposed to patient demand for antibiotics. "Differences in antibiotics consumption are driven by differences in patient populations and differences in physicians practice styles." Understanding the contribution of each stakeholder provides evidence to design effective policies. To that extent, the authors use antibiotics prescription from GPs in Denmark leveraging changes in the patient-physician relationship when a physician exits the practice. They estimate that physician practice style contributes to more than half of the differences in the log of antibiotics

[1] The number of bacterial cases treated.

consumption between clinics with a larger effect (up to 80%) for second-line antibiotics. Higher prescribing intensity does generate best overall health outcomes as it does not result in less preventable hospitalization.

In the second part of the session, **Pierre Dubois** from TSE presented ongoing work with **Gökçe Gökkoca** focusing directly on the choice of antibiotics among the set of drugs available, questioning whether AMR affects the choice of treatment.

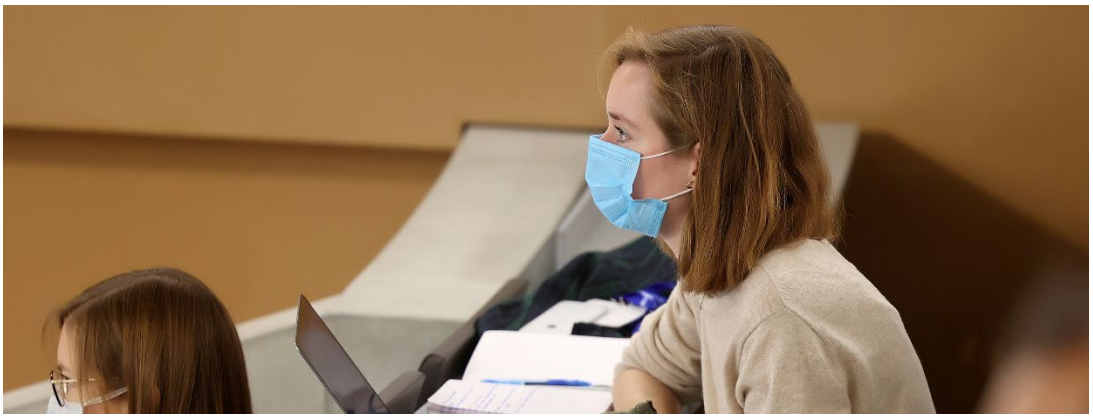
They provide an economics modeling of treatment decision in which the physician considers the level of resistance of the bacteria to each treatment and bacterial resistance evolves dynamically to account for both human and animal use of antibiotics. By providing estimates of substitution patterns across treatments, they are able to consider treatment choice under alternative levels of resistance and conclude: "Bacterial resistance affect prescription behavior and is costly." Physicians are taking into account the bacterial resistance to each treatment when deciding on the prescription. Banning animal usage of antibiotics would induce lower-cost treatment choices and increase patient's welfare.

The first three sessions of the day emphasized the spread of AMR and the determinants of antibiotics prescriptions. The goal of the last session was to provide preliminary evaluation of policies that have been implemented to fight AMR.

The first part of the session considered policies aiming at reducing physician's prescriptions of antibiotics to limit the evolution of bacterial resistance to existing treatments. To that extend, **Gökçe Gökkoca** from TSE studies the 2017 extension of the financial incentives towards less antibiotics prescriptions in the French Pay-For-Performance system. The incentive scheme provides a monetary reward to physicians reaching low levels of antibiotics prescriptions. This extension tightened the target rate of overall antibiotics prescriptions and introduced a particular concern to limit the use of antibiotics that are generating more resistance. In an ongoing work, the author provides preliminary evidence that physicians react to the policy by further reducing their initial level of antibiotics prescriptions to reach the new threshold as well as changing the type of antibiotics prescribed, decreasing the share of restricted drugs prescriptions. Physicians did not react to the policy with the same intensity and future work will assess the efficiency of the policy, but it seems to be good at targeting physicians with high prescribing behavior.

Summary

In the second part of the session, **Gosia Majewska** from TSE presented an ongoing work on the effectiveness of innovation incentives to stimulate the development of new antibiotics. "Two types of policies have been implemented" explains the speaker "Pull incentives increase the reward associated with market entry of a new drug while push incentives aim at reducing the cost associated with drug development." In particular, pull incentives granting five years of market exclusivity and expedited review by the FDA, the US regulator, have been part of the 2012 Generating Antibiotics Now (GAIN) act. Push incentives affect the funding of the research stages. Analyzing R&D pharmaceutical projects since 2000, the author's results suggest that the projects qualified to benefit from pull incentives were already in later stages of development and that the policy is targeting projects with a higher initial probability of success. On the contrary, there is no evidence of positive effects on more innovative projects. By helping firms to fund different research stages, push incentives are associated with an increase in the probability of success in clinical trial.



Thank you to **Léa Bignon** for her summary of this event.

More information about this event can be found at tse-fr.eu/workshop-economics-antibiotics