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UMEÅ SCHOOL OF BUSINESS, ECONOMICS AND STATISTICS

Jameel Institute

Workshop on the Economics of Pandemic Preparedness

EVENT REPORT

WRITTEN BY ELLIE FARROW

Contents page

Foreword

On the 2nd and 3rd of June 2025, Umeå University, Sweden and the Jameel Institute, Imperial College London, were delighted to host the second annual workshop on the economics of pandemic preparedness. This interactive workshop provided a forum to encourage dialogue and collaboration between economists and epidemiologists who are working at the intersection between both of these fields to make the world better prepared for the next pandemic, by advancing research that provides actionable evidence to policy makers on how to combat epidemic infectious disease threats. Over 20 academics came together to present, discuss and strengthen their ongoing and future research, ideas and projects.

This year, we were pleased to welcome two esteemed keynote speakers. First, we welcomed Dr Victoria Ogden. Drawing on her time at the HM Treasury during the COVID-19 pandemic, Victoria shared how policymakers used novel data, models, and external collaborations to overcome policymaking challenges.

Second, we welcomed Professor Raouf Boucekkine, from Aix-Marseille Université, who presented his research modelling the interplay between epidemics, mental health and public trust; themes of relevance to many of the presentations throughout the workshop.

With the workshop location near Nacka Strand on the waterfront, and with our visit coinciding with the turn of the Swedish summer, we were fortunate to also be able to enjoy time together in the sunshine and scenery between presentations.

Plans are underway to host our third workshop in Stockholm next June, expanding the scope to cover the economics of both epidemic and endemic diseases. We hope to welcome many of you.

Best wishes,

Giovanni Forchini,
Professor of Econometrics, Umeå University

Katharina Hauck,
Professor in Health Economics and Deputy Director Jameel Institute, Imperial College London

Executive Summary

The workshop was attended by academics working at the interface between economics and epidemiology. With much to learn from each other, the workshop was structured around presentations where authors presented their ongoing research, which was then followed by a short review from discussants. This peer-review process not only created an open forum for discussion and debate, but crucially, also provided authors with feedback to strengthen their research.

The value of bringing attendees together in such a format extended beyond the individuals themselves. The collaborative sharing of research provided an insightful opportunity to build bridges of understanding between disciplines, research institutions, and countries, and in doing so, strengthen us all against future pandemic threats.

This bridge-building and bridge-strengthening navigated around five central themes.

First, many of the talks over the two days, including the opening presentation by our keynote speaker Victoria Ogden, were policy action orientated. From hearing about how the UK's treasury adapted and overcame COVID-19 policy challenges by using new data and modelling approaches, to what vaccination incentives were shown to be most powerful in Sweden on an individual level, several of our speakers took to the floor to reflect on what our recent pandemic past has taught us and shared what lessons should be carried into the future.

A second core theme over the course of the workshop was using modelling approaches to dig into the socio-economic and behavioural drivers of pandemic outcomes. For example, presentations touched on the role of mental health, ethnicity, deprivation, age, and trust as determinants of economic and epidemiological outcomes during a pandemic context.

In doing so, several of our workshop presenters improved collective understanding of the causes of societal inequality and how it can be addressed.

A few sessions brought economic and epidemiological modelling together to evaluate the impact of disease interventions, notably on the provision of vaccination programmes in LMIC contexts. By contrast, other sessions used integrated modelling approaches to adopt a broader focus looking at the impact of pandemics on aspects of the economy, such as on labour markets, productivity, and inflation. Finally, over the course of the workshop we were fortunate to hear from academics who are at the forefront of understanding and developing near integrated economic-epidemiological modelling approaches.

This report summarises each presentation under these five broad themes:

Theme 1: Optimizing public health policy trading off health, economic and mental health outcomes

Theme 2: Modelling socio-economic and behavioural determinants of health

Theme 3: Analysing economic impact of disease interventions

Theme 4: Modelling pandemic economies at scale

Theme 5: Novel integrated economic-epidemiological modelling methodologies

As we close on this year's workshop, we look ahead to 2026. We will be welcoming everyone to Stockholm again next year for a third workshop on the economics of endemic and epidemic threats, providing a forum once more to share and discuss the latest research at the intersection between epidemiology and economics.

Theme 1: Optimising public health policy trading off health, economic and mental health outcomes

Keynote speech: Victoria Ogden: The application of epidemiological and economic modelling to support policy development

Victoria Ogden, from HM Treasury, UK Government, focused her keynote address on her time at the treasury during the COVID-19 pandemic, the challenges they faced, and how they innovated to overcome them.

Victoria set out the UK Government's objectives to prevent the spread of Covid-19 and protect the economy, and spoke to three broad issues that they were focussed on:

*Preventing long-term unemployment

*Protecting the most vulnerable and those who were disproportionately impacted

*Enable a rapid recovery when public health measures were lifted

Economic analyses informed the policy decisions that were made in efforts to achieve these three priorities. Yet while the Treasury maintained a suite of macro-economic models prior to the pandemic, they did not have a ready-made toolkit to model the effects of a national lockdown in a global pandemic. Models therefore needed to be ***"adapted, extended and - in some cases - fundamentally rethought."***

Victoria's experiences at the treasury during this time taught her four key lessons. First, the importance of using novel data sources; the speed and scale of the global pandemic meant the treasury could not the speed and scale of the global pandemic meant the treasury could not rely on a pre-existing data toolkit and had to use new sources such as the COVID-specific survey data collected by the Office for National Statistics.

Second, the necessity of integrating a wide range of data and perspectives – economic and epidemiological, domestic and international, qualitative and quantitative. These diverse perspectives were needed to give more nuanced, richer and robust answers to pressing yet complex policy questions.

Third, the need for interdisciplinary and inter-institutional collaboration with, amongst others, the Bank of England, International Monetary Fund and Royal Economic Society.

Finally, a heightened requirement to communicate with the public, particularly on uncertainty in modelling projections and forecasts.

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Key pandemic takeaways are the importance of:

*Using novel data sources
*Integrating a wide range of data and sources

*Interdisciplinary and inter-institutional collaboration

*Communication with the public

Erik Wengström: Incentives to Vaccinate

Erik Wengström, from Lund University, presented his research examining the effects of monetary incentives on health behaviours. His research drew on data from a randomised controlled trial conducted in Sweden in 2021, where participants were offered one of three monetary incentives for getting a COVID-19 vaccine booster: a smaller guaranteed monetary pay-out for their own use, entry into a lottery where they stood the chance of receiving a larger monetary pay-out, or a guaranteed smaller monetary pay-out donated to a charity. Erik and his co-authors found that uptake of the booster was highest among those who were guaranteed a monetary pay-out for their own use, with no evidence of backfiring or negative consequences for vaccine uptake in the longer term. This suggests monetary incentivisation may be a safe and effective policy action. Erik is now testing the effectiveness of incentivisation in a low income setting in Burkina Faso, and whether it varies with the organization or person providing the pay-outs.

Kanchan Parchani: Assessing the health and economic contributions of migrant workers in Singapore during the COVID-19 pandemic: an integrated epidemiological-economic modelling based analysis

Kanchan Parchani, from Imperial College London, presented her ongoing research modelling the health and economic impact of different border and travel restriction scenarios in Singapore. Some economic sectors in Singapore are heavily reliant on a non-resident workforce, which experienced significantly higher rates of infection compared to the resident population during the COVID-19 pandemic. To facilitate this research, Kanchan is utilising DAEDALUS, an integrated epidemiological-economic model developed by Imperial College London, with the current modelling focus being the simulation of health and economic outcomes for the non-resident workforce involved in the construction industry specifically. The model will be used to implement 'what-if' scenarios such as the impact of earlier or delayed lockdowns of non-resident workers' dormitories, and to identify thresholds for transmissibility and severity under which business-as-usual or elimination strategies can be implemented for similar health crises in the future.

Patrick Doohan, Imperial College, Mitigating Future Respiratory Pandemics: Modelling the Health, Economic and Educational Losses of Alternative Mitigation Strategies in Different Income Groups

Patrick Doohan, from Imperial College London, discussed his work on mitigating future respiratory pandemics using Imperial College's DAEDALUS model. His findings show how variability in context (i.e. disease archetype, country characteristics and economic structure) influences the optimal mitigation strategy. The strategies modelled include no closures, school closures, economic closures, and a full elimination strategy, and the model accounts for losses due to years of life lost, business and school closures. His results show that the optimal or loss minimising strategy is dependent on both disease and income level, driven by both a country's demographic structure and its hospital capacity.

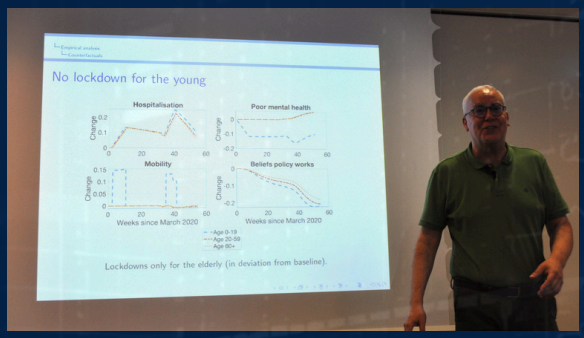
Theme 2: Modelling socio-economic and behavioural determinants of health

Keynote speech: Professor Raouf Boucekkine: Epidemics, mental health and public trust

Professor Raouf Boucekkine, from Aix-Marseille Université, presented his research on epidemics, mental health and public trust. His research provides evidence to public authorities on the public's trust in the efficacy of pandemic mitigation measures, and how the public's compliance with stringent pandemic mitigation measures impacts mental health.

Raouf and his team built an epidemiological SIR model with endogenous mobility decisions, investigate how mobility restrictions and adherence to lockdowns affects mental health. Rich real-time data in France – including geo-localised mobile phone data on mobility, and data on regional consumption of psychotropic drugs was used to calibrate the model. Modelling results showed that containment policies like lockdowns lead to a gradual decline in mental health. This decline is driven by the reduction in mobility and increase in distrust in the effectiveness of the containment policy.

Raouf and his coauthors explored in scenario modelling the effects of a stricter lockdown (as was seen in France in 2020) compared to a more relaxed lockdown which enabled children to continue to go to school (as was introduced in Sweden in 2020). The scenarios showed that even in the absence of a strict containment policy like a lockdown, people may voluntarily restrict their mobility with detrimental impact on mental health.



Christian Morgenstern: Socioeconomic and temporal heterogeneity in SARS-CoV-2 exposure and disease in England from May 2020 to February 2023

Christian Morgenstern, from Imperial College London, presented his research modelling the socioeconomic and temporal heterogeneity in SARS-CoV-2 exposure and disease. He drew on the rich data that was collected in England during the pandemic to analyse infections, hospitalisations, deaths and vaccination records. Poisson regression models were adjusted for demographic and temporal factors. Model results demonstrated that the risk of severe infection outcomes varied by ethnicity and deprivation, and that risk varied over time, with a reduction in risk

heterogeneity in the post-vaccination period. Non-white and the most deprived communities were more severely impacted in England, suggesting the persistence of pre-existing health inequalities during the pandemic. Christian drew the conclusion that for future pandemics, national policymakers need to be cognisant of, and responsive to, how ethnicity and deprivation can increase the risk of negative health outcomes. This awareness is of particular importance in the early stages of an outbreak.

Nicole Goh: Inequalities in Mental Health: Age-related Trends Across Pandemic Phases in Singapore

Nicole Goh, from the National Centre for Infectious Diseases, Singapore, presented her work on inequalities in mental health during Covid-19. Nicole analysed population-wide psychological trends during COVID-19 restriction phases in Singapore, and differential trends by sociodemographic groups. She leveraged a patient health questionnaire to measure symptoms of anxiety and depression across the pandemic, and a linear regression model to chart these symptoms across different age groups and chronological timepoints associated with major policy changes. The model results showed that younger age groups were more anxious and depressed after lockdown measures were lifted while older age groups saw a decrease in these psychological symptoms. This suggests an age-related advantage in psychological resilience following a pandemic, and the potential need for more intervention and support for younger age groups. As a next step, Nicole will be exploring the link between self-reported mental health scores and health care utilisation.

Haokun Pang: Health and Economic Inequality During Pandemics

Haokun Pang presented his research examining the co-dynamics of health and wealth inequality during the pandemic. This was achieved by integrating a heterogeneous agent continuous time (HACT) model with a SIRS (susceptible, infected, recovered) model. The model design allowed the exploration of behavioural dynamics, disease dynamics, health disparities and inequality dynamics. Modelling results showed that infection rates for poor individuals are higher and income and wealth equality worsened during the pandemic. Income support during infection could improve equality during a pandemic, however if support is unconstrained, it can negatively impact economic production.

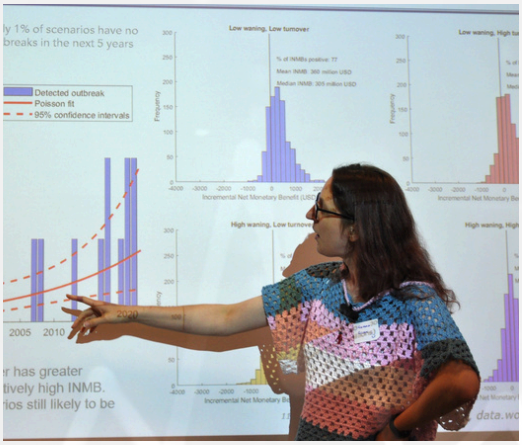
David Haw: Modelling Epidemics with Behavioural Heterogeneity

David Haw, from the University of Liverpool, presented his research which built a simple behavioural-epidemiological model to reveal the behavioural profile of the population. This is in response to the well-acknowledged, but sometimes difficult to measure, role of behaviour in mediating links between economic and epidemiological outcomes. David used data on hospital admissions, public perceptions of the state of the COVID-19 pandemic, and on stringency of mitigation measures, to inform three behavioural parameters: perceived risk, trust, and policy response. David's model findings demonstrated that the addition of these behavioural parameters alongside natural history parameters can be helpful in identifying behavioural drivers of transmissions in a new outbreak. Future work will focus on identifying key behavioural archetypes.

Theme 3: Modelling economic impacts of disease interventions

Gemma Nedjati-Gilani: What is the 5 year cost-effectiveness of a onetime, preventative vaccination campaign of healthcare workers and front line workers against Ebola Virus Disease?

Gemma Nedjati-Gilani, from Imperial College London, presented her research using an individual-based, stochastic simulation model to estimate the epidemiological impact and cost-effectiveness of a preventative healthcare and frontline worker vaccination programme against Ebola. Gemma's research aimed to understand what level of vaccination coverage needs to be achieved to make vaccinations cost-effective, what factors impact cost-effectiveness, and in what situations a vaccination campaign may not be effective. Her model results showed that preventative vaccination campaigns targeted towards healthcare and frontline workers avert cases, deaths, and the number of vaccines required in an outbreak. Vaccination campaigns are also highly likely to be cost-effective when deployed in high-risk areas prone to frequent outbreaks, however cost-effectiveness is impacted by waning immunity and staff turnover rates.



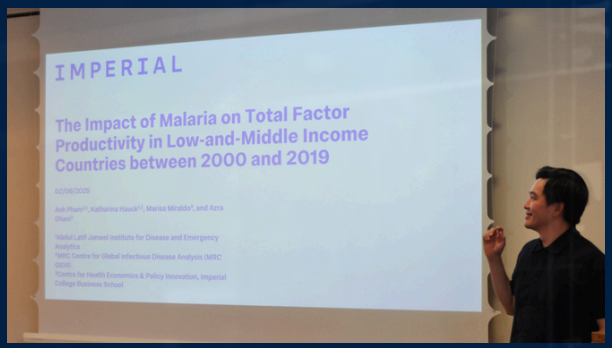
Pablo N Perez-Guzman: Optimal cost-effectiveness of implementing CEPI's 100-day mission under epidemiological uncertainty in low-income settings: a health economic modelling study of COVID-19 in Kabwe, Zambia

Pablo Perez-Guzman, from Imperial College London, presented his research centred on the Kabwe district in Zambia. Like many LMICs, a population-wide COVID-19 vaccination programme was not implemented in Zambia until late 2021, nearly one year after high-income countries. . His research examined whether it would have been cost-effective for Zambia to adopt a vaccination programme in line with CEPIs 100 day mission, the ambition to enable global vaccine access within 100 days of a new pandemic pathogen being sequenced. He also analysed what aspects of the design and delivery of such a programme would make the program cost-effective. Pablo developed a stochastic, compartmental epidemiological-economic model to track disability-adjusted life-years averted, incremental costs to the health system, and per-vaccine dose delivered. Model results suggest that implementation delays and programmatic factors such as the eligibility age for vaccination and vaccination rate need consideration as they may impact cost-effectiveness.

Theme 4: modelling pandemic economies at scale

Anh Pham: The Impact of Malaria on Total Factor Productivity in Low- and Middle-Income Countries between 2000 and 2019

Anh Pham, from Imperial College London, presented his work on estimating the impact of malaria on productivity in low- and middle-income countries (LMICs). To achieve this, he used an Instrumental Variable analysis. Anh demonstrated that the impact of malaria on total-factor productivity is comparable to air pollution, with a 10% rise in malaria incidence associated with a 0.3-0.8% decline in total-factor productivity. From a health system resourcing perspective, Anh's work demonstrates the crucial importance of including the benefits of averted productivity losses in cost-effectiveness analysis and the need for malaria elimination programmes to support sustainable development in LMICs.



Bilal Sali: Econometric modelling of public health and the economy: COVID-19 in Norway

Bilal Sali, from the University of Oslo, presented his framework of an empirical model that jointly shows the effects of COVID-19 on health (specifically, on new cases, hospital admissions and hospital admissions) and the economy on a daily frequency. This is in response to the policy challenge whereby health and economic impacts are often forecast on different timescales. To develop this joint model, Bilal created a daily value for GDP growth by using a combination of national accounts and daily economic indicators like the Financial News Index. Following model simulation, the effects of policy action and public disease awareness on the aforementioned health and economic model indicators were disentangled. The modelling results showed that policy action and disease awareness impacted on GDP, and that these were greatest at the start of the epidemic. The latter finding could be explained as individuals, businesses and the Norwegian government learnt to adapt to the pandemic over time.

Seunghyun Hong: The 20-Year Impact of Pandemics on Households: Local Projections for Six European Countries Since 1870

Seunghyun Hong, a recent Master's student from Imperial College London, presented his work assessing the impact of historic pandemics on the economies of six European countries, using data spanning the cholera epidemics of the 1870s up to the H1N1 Swine Flu pandemic of 2009. His work used local projections to estimate the response function of six macroeconomic variables, including inflation, labour productivity and real wages, up to 20 years following the end of a pandemic event. The results showed a deflationary effect in the 7 years post-pandemic, combined with a slightly longer period of increased labour productivity and real wages. However, the results also showed the impact of pandemics were different across countries, revealing a North-South split in the economic impacts.

Guillaume Morel: Essential, non-essential, and the economics of outbreaks: a two-sector new-Keynesian approach

Guillaume Morel, from Umeå University, Sweden, presented his research developing a two-sector New Keynesian Dynamic Stochastic General Equilibrium (DSGE) model integrated with a a dis-aggregated SIRS (susceptible, infected, recovered) framework separating essential and non-essential sectors to study the economic impact of pandemic events. Separating into these two sectoral groupings allowed Guillaume to examine the different impacts of a pandemic on labour supply, consumption and investment in essential versus non-essential sectors. Model findings point towards essential sectors suffering disproportionate economic impacts during an unmitigated pandemic due to higher exposure to infection. Controlling the pandemic with mitigation measures is usually less costly than not mitigating a pandemic. Further, the model suggested vaccination programmes have a stabilising effect on the economy via both the essential and non-essential sectors, protective equipment can delay the peak of infections, and lockdowns can be very effective at limiting transmission of disease but with severe and disruptive economic impacts.

Francesco De Pretis: A pandemic-prepared pharmaceutical industry: Uncertainty and incentives for innovation.

Francesco De Pretis, from the University of Modena and Reggio Emilia, presented his expert opinion work highlighting market failures for the development of pandemic disease antivirals and potential pathways to address them. He argued that broad-spectrum antivirals are attractive drugs to bridge the treatment gap during the early stages of a pandemic, whilst virus-specific vaccine are developed. Francesco showcased that during the COVID-19 pandemic, however, there was an under-supply of such antivirals. He outlined three main policy levers to incentivise pharmaceutical companies to produce antiviral compounds of potential use in future pandemics: issuing exclusivity patents and patent extensions, facilitating auction marketplaces for novel compounds under development, and improving post-market pharmacovigilance with the aid of Artificial Intelligence, in order to lower litigation risks and improve public trust.

Aditya Goenka: Labour markets during pandemic

Aditya Goenka, from the University of Birmingham, presented his research investigating to what extent infection dynamics can help explain the observed changes in the labour market during the COVID-19 pandemic, and what the long term consequences of a pandemic like COVID-19 on the labour market might be. Aditya used a heterogenous agent framework including an epidemiology compartmental model that allowed for two way interaction between the economy and disease prevalence. After calibrating the model to UK data, Aditya could show that the labour market tightens even in the instance of a milder pandemic. To avoid income losses, workers downgrade their job search and are prepared to accept lower paid wages compared to pre-pandemic, and income, wealth and wage inequality slightly increases.

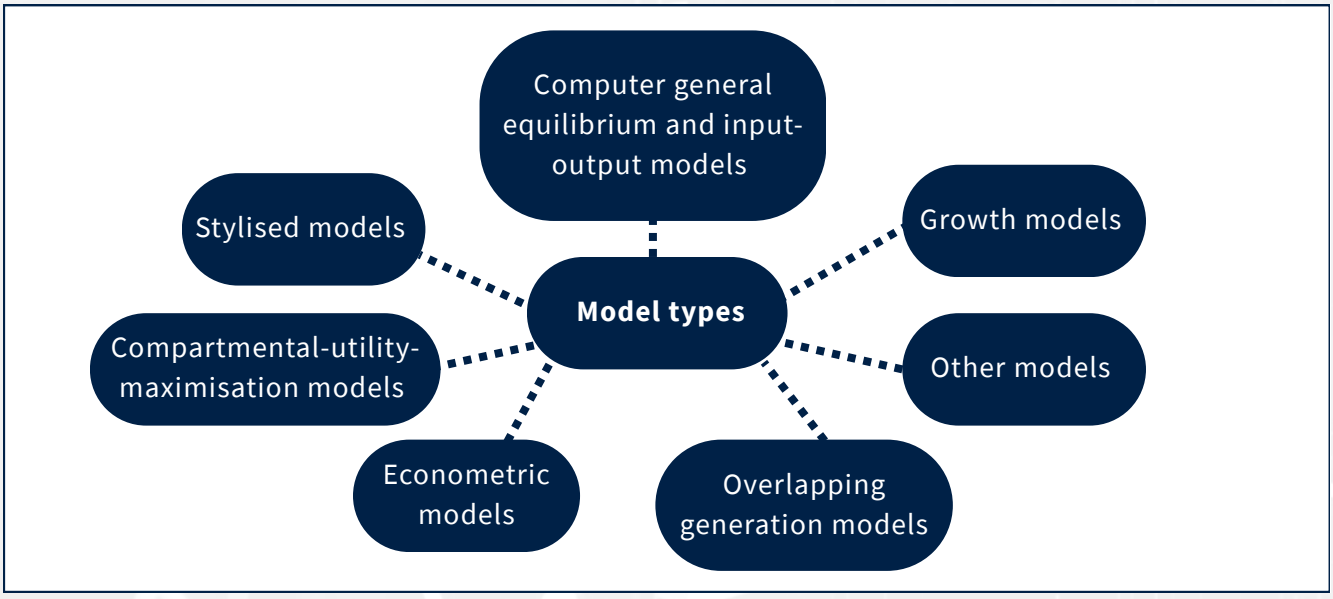
Theme 5: Novel integrated economic-epidemiological modelling methodologies

Gabrielle Bonnet: Joint epidemiological and macroeconomic models of human disease – a systematic review

Gabrielle Bonnet, from the London School of Hygiene and Tropical Medicine, presented her findings from a systematic review of macroeconomic-epidemiological models. Gabrielle's review identified 59 macroeconomic-epidemiological models that met the review's search criteria. The majority of the models focused on HIV/AIDs, influenza and SARS-CoV-2. Gabrielle categorized the models into 7 types: computable general equilibrium and input-output models, growth models, overlapping generation models, econometric models, stylised models, compartmental-utility-maximisation models, and other models. The model types each have their own strengths and limitations, such as the timeframe they can simulate, the number of economic sectors that can be accounted for, and the configuration of the feedback loops between model components. This variation allows the exploration of different research questions.

Rob Johnson: Towards an epidemic and stock-flow consistent integrated model

Rob Johnson, from Imperial College London, presented his ongoing work on an epidemiological-economic model that integrates stock-flock consistent models from economics with compartmental models from epidemiology and demonstrates how the modelling framework can be used in the exemplar case of a respiratory infection. One of the key methodological benefits of this approach is that both SFC and compartmental models are written as systems of ordinary differential (or difference) equations (ODEs), which provides a natural interface between the epidemiological and economic components of the model and avoids mismatched timescales between the two systems.



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