**////Title: Immigration, Epidemic Mortality and Demographic Recovery**

**////Stand-first**:

Dr Pierre Galanaud, an immunologist from Paris-Saclay University and Inserm UMR 996, analysed historical tax records to investigate the impact of epidemics on recent emigrants who experienced the 15th century plagues in Dijon, France. His research highlights the vulnerability of emigrants with low economic status to epidemic-related mortality. More broadly, his work demonstrates the important role that migrants play in population growth and demographic recovery after an epidemic has taken place. These findings are of particular relevance given the current COVID-19 pandemic.

**////Body text:**

In the midst of the COVID-19 crisis, epidemics and pandemics might feel like a very modern phenomenon. However, throughout history there have been numerous instances where transmittable diseases have spread at an alarming rate, infecting high volumes of the population.

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One of the most intensively studied diseases is the plague pandemic that emerged in the mid-14th century in Western Eurasia by a deadly epidemic known as the Black Death and reoccurred many times thereafter.

Historical records provide vital clues in our efforts to piece together an understanding of past epidemics. And recently, scientists have been able to uncover further information by looking at microbial DNA within human remains.

Contrary to initial assumptions, detailed analysis of bacterial DNA from victims of the Black Death and following epidemics has revealed that the recurrent outbreaks and unusual severity may have been due to external factors rather than its genetic make-up. These factors include the environment, the way the pathogen was transmitted, and the susceptibility of individuals to contracting it. Such susceptibility to infection can be affected by many factors, including frailty, age, gender and socio-economic status.

Population movement may also have influenced the likelihood of contracting and/or dying from the plague. In medieval times, people who had immigrated to urban areas may have been more vulnerable due to poverty and poor housing.

Dr Galanaud argues that understanding the role of population movement in historic epidemics may help to raise awareness about important vulnerabilities in present day outbreaks. His investigations focus on mortality during the early 15th century epidemics that occurred in Dijon, France.

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Working with a multidisciplinary team including a historian (Anne Galanaud), a computer scientist (Henri Labesse) and an eco-epidemiologist (Patrick Giraudoux), Dr Galanaud analysed annual tax records known as the Marcs Register. These documents provide information on the demographics of residents in Dijon over a century and half of the late medieval period. Heads of each household were listed as part of these records, and information about their tax level provides clues about their socioeconomic status, while those deceased during the year of tax collection were quoted. The registers thus contain information about mortality, although the cause of death was not listed.

Patterns of high mortality over specific time periods helped the researchers identify when epidemics may have taken place. Unfortunately, the records do not account for everyone living in Dijon at this time. A given head of household was registered for his/her whole family. Most of them were males, because in medieval times females acquired the status of head of household when they were widows (and lost it if they married again), preventing analysis of gender influence. Although the poor were quoted and exempted from the tax, their registration was probably less exhaustive than that of solvent households.

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Dr Galanaud and his co-workers had designed a computer programme to analyse over 100,000 records from the Marcs Register, identifying about 13,000 heads of households with a definite socio-economic status, locatable home, duration of presence and often profession. They focused on two different epidemics in the early–mid 15th century, studying the years of each epidemic and the years before and after the epidemics. In order to identify people who had immigrated to Dijon, they reviewed two key pieces of information. The first was the time period between each individual’s first registration and the epidemic taking place. The second was their family links to others in the register.

Dr Galanaud’s rationale was that the most recently registered were newly settled. Among them, those who had family ties in Dijon were previous inhabitants of the city established as independent citizens, whereas those who did not have such ties were potentially newcomers who had settled in the city as immigrants.

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The results from the first epidemic provide evidence for immigrants having a specific vulnerability to plague-related mortality.

Whereas during uneventful years, less than 5% of heads of households were reported dead, in 1400 – a year when plague is documented all over Europe – 16% of the heads of households died. In all probability, the excess mortality of heads of households was plague-related and reflected that of the whole population. During uneventful years, mortality was not influenced by the socio-economic level and was higher among those registered for a longer time, in accordance with their probably older age. In contrast, during the year of plague, higher mortality was observed for heads of households who cumulated a low tax level, a recent registration and a lack of family links. Among them, one out of three died, which suggests that poor recent immigrants were preferential victims of the epidemic.

These findings are in line with previous studies pointing out the vulnerability of migrants to epidemic-related mortality. Analysis of the remains of London’s Black Death victims revealed that some were from distant regions of the UK, indicating they must have relocated to the city. In Milan, the mortality rate during the plagues in the late preindustrial era was higher for emigrants from surrounding villages. A much more recent example can be seen in the USA, where newer Latino communities had a higher rate of COVID-19 than people of similar socioeconomic status who were from more established communities.

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A further intriguing aim of Dr Galanaud was to assess the role that migrants may have played during the post-epidemic period. The 1400 epidemic was followed by a prolonged demographic decline whereas after a second major epidemic that occurred in 1438–1439, the number of households increased once the political and economic climate had improved. As expected, the number of new heads of households was higher in the years following the latter epidemic. This difference is entirely accounted for by individuals devoid of familial link in the city who paid low taxes, who in all probability were poor immigrants. These findings suggest that newcomers were integral to the population growth and urban expansion that took place in Dijon later in the 15th century.

Dr Galanaud’s research plays an important role in highlighting the vulnerability of poor immigrants to epidemic-related mortality. These communities that need protection during the epidemics are essential for post-epidemic population growth and demographic recovery following the devastation and loss caused by disease.

This SciPod is a summary of the paper ‘[Mortality and demographic recovery in early post-black death epidemics: Role of recent emigrants in medieval Dijon](https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0226420)’, published in the open access journal PLOS One (https://doi.org/10.1371/journal.pone.0226420) and the letter ‘[Recent immigrants at increased pandemic risk](https://www.science.org/doi/10.1126/science.abd1098?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%20%200pubmed)’ published under open access in the journal Science (https://www.science.org/doi/10.1126/science.abd1098).

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