



UNDERSTANDING OPIOID PRESCRIBING BEHAVIOR IN ENGLAND

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BBSW/BARUG Meetup, February 20, 2020

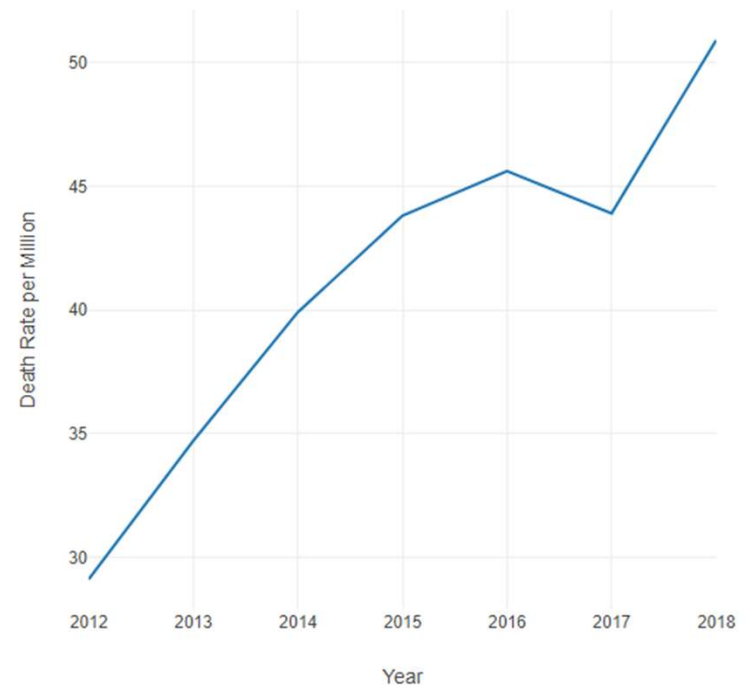
AGENDA

- Trends in drug misuse death rates in England
- The relationship between prescription opioids and drug related deaths
- Patterns and trends in opioid prescribing behavior
- Modeling the drivers of opioid using a spatial panel approach in R
- Policy implications of the model

RISING DRUG MISUSE DEATH RATES

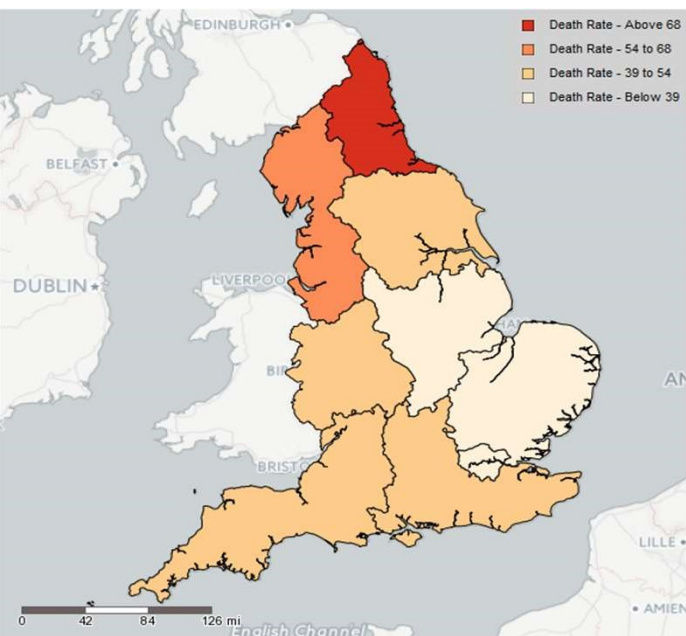
- Annual drug misuse death rates have increased by nearly 75% between 2012 and 2018
- Over half of all drug misuse deaths are associated with opiates

Age Standardized Drug Misuse Death Rates

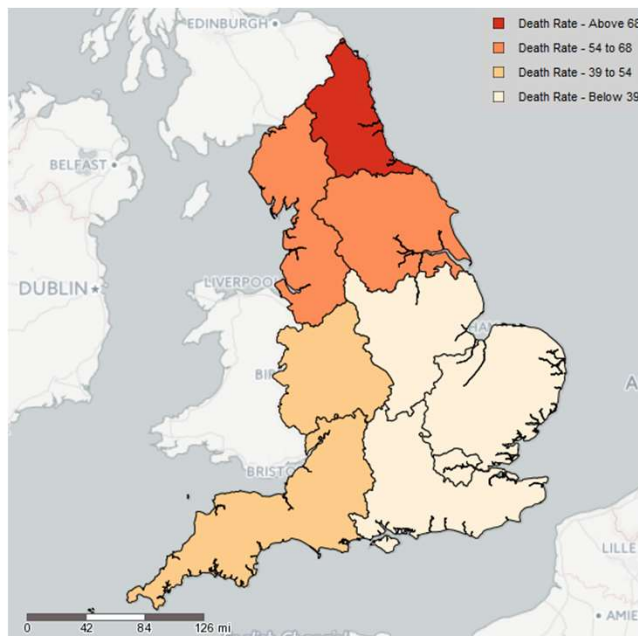


DRUG MISUSE DEATH RATES BY REGION

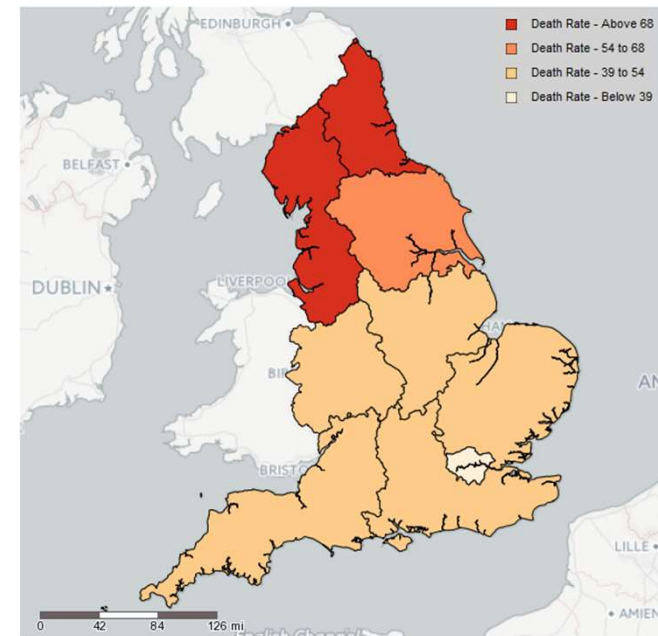
2016



2017



2018

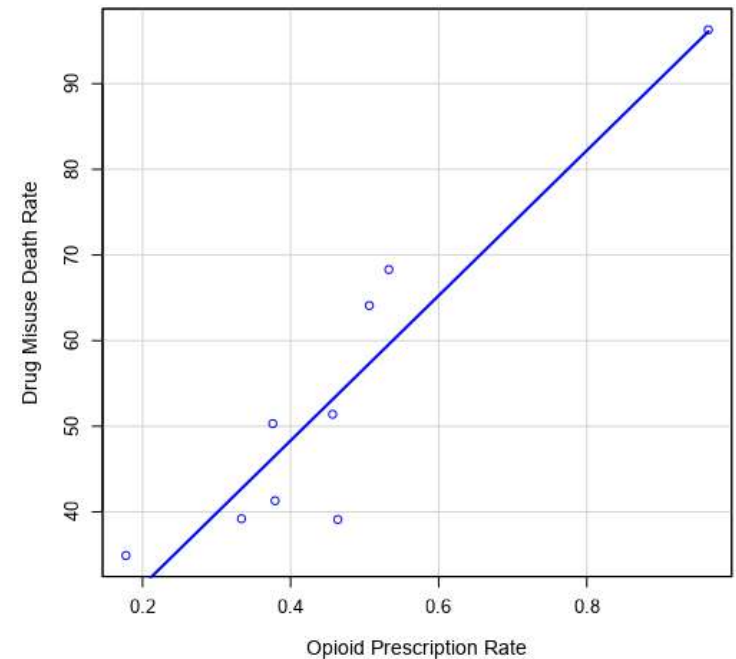


Source: Office of National Statistics

OPIOID PRESCRIPTION RATES AND DRUG DEATHS

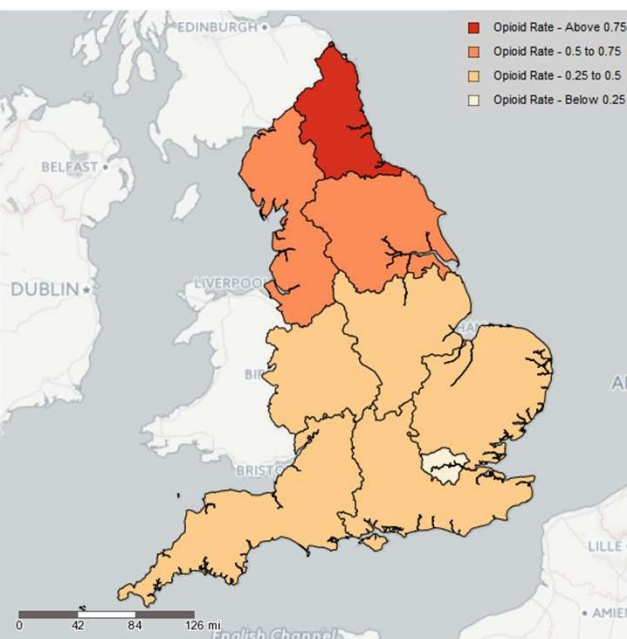
- US Research has shown that prescription opioids act as a gateway to illegal drug use
- Consistent with this, the correlation between opioid prescription rates and drug misuse death rates is over 0.9 across England's nine regions

Scatterplot of Opioid Prescription Rate versus Drug Misuse Death Rate



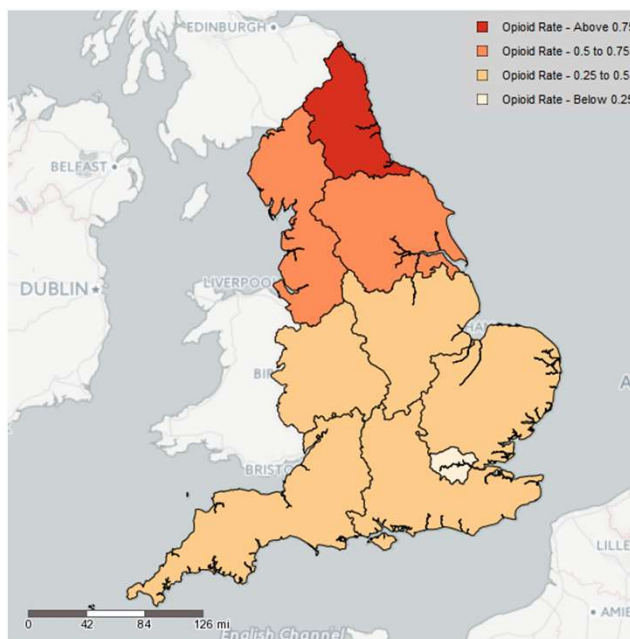
THE STABILITY OF OPIOID PRESCRIPTION RATES

2016

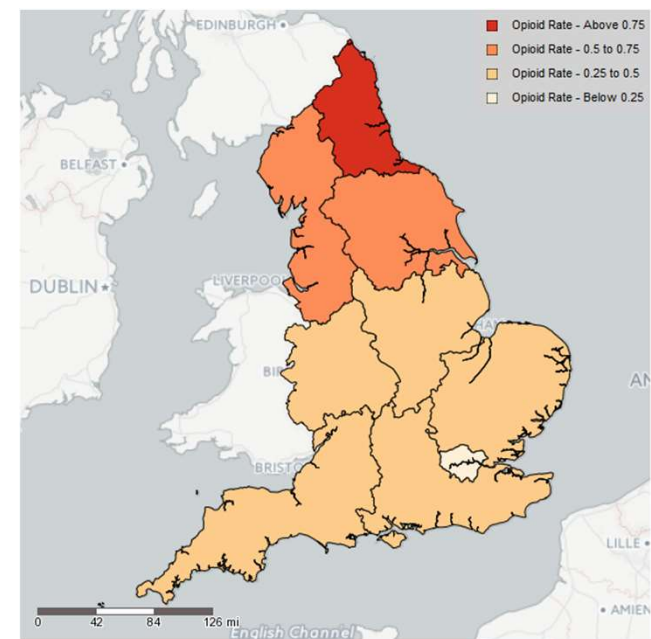


Source: National Health Service

2017



2018



ISSUES FACING PUBLIC HEALTH AGENCIES

- Can public health programs be developed to lower opioid prescription rates?
 - What should be the nature of any programs developed?
- What are the drivers of opioid prescription rates across England?
 - Do some of the drivers lend themselves to public health intervention efforts?



POSSIBLE DRIVERS OF PRESCRIPTION RATES

- Economic opportunity
 - Household income levels (-)
 - Working age unemployment (+)
- Household structure and composition
 - The percentage of households with children present (-)
 - The percentage of households headed by married couples (-)
- The age of the population
 - Measured as the average age of the population 18 years and older (+)
- Local area “standard of care” (+/-)



ADDRESSING LATENT FEATURES IN DATA SCIENCE

- Meaningful predictors are often not directly observable
- Related observable features are used to infer the unobservable
- Two basic approaches exist to do this
 - Separate from model training (e.g., factor analysis, word embeddings)
 - As part of model training itself
- When done in model training, additional structure needs to be imposed
 - Adding the needed structure relies on the use of parametric statistical models
- In this use case a spatial “lag” model is needed



OTHER DATA AND MODELING ISSUES

- Much of the available data is on an area level
 - There are only nine regions in England
 - It is not possible to map practices to low level geographies
 - Using the 195 Clinical Commissioning Group areas (circa 2018) works
- Socioeconomic and demographic factors are often highly correlated with one another across areas
 - Increasing the number of observations partially alleviates the multicollinearity problems
 - Three years of data can be used to triple the number of observations
 - Doing this results in a “panel data” situation that needs to be addressed using a “random effects” approach



THE MODEL TAKEN TO THE DATA

$$y = \lambda(I_T \otimes W_N)y + X\beta + u$$

- W_N is a spatial weight matrix
 - A value of 0.2 is given in the matrix if an area is one of the five closest to an area, and is zero otherwise
- This is a very specialized model type
 - The R spdep package is used to construct the spatial weight matrix
 - The R splm package is used to estimate the model



THE SPATIAL WEIGHT MATRIX

K nearest neighbors, $k = 5$



DATA SOURCES

- MB-Research
 - Area level disposable income
 - Number of individuals unemployed
 - Households with children present
 - Households headed by a married couple
- Office of National Statistics
 - Total population
 - Average age of the population for those 18 years or older
- National Health Service
 - Opioid prescriptions

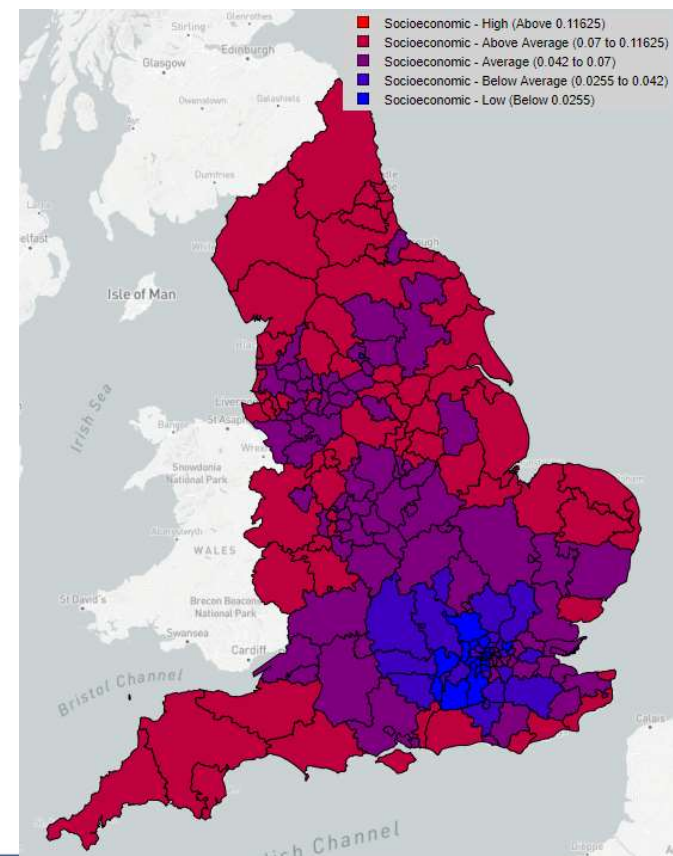
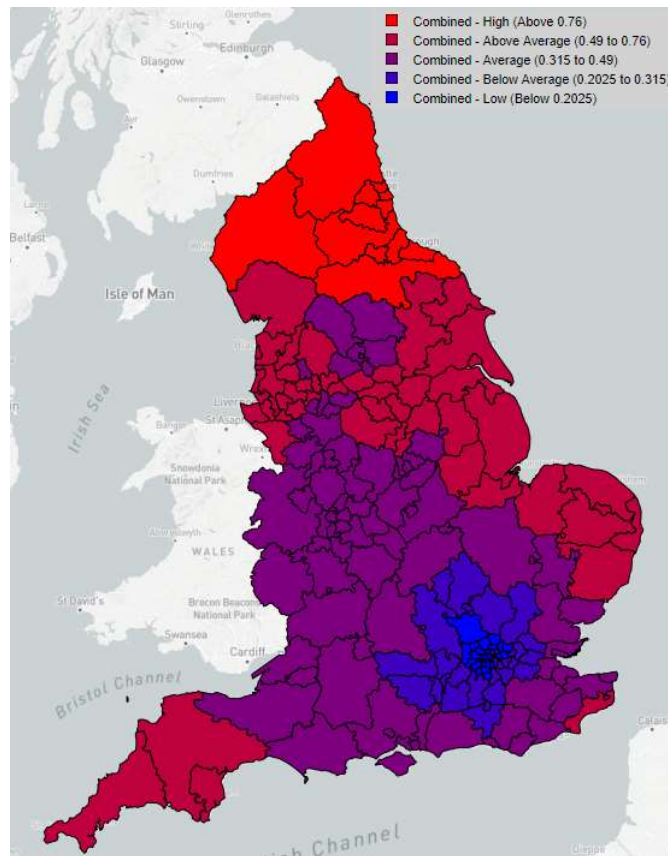
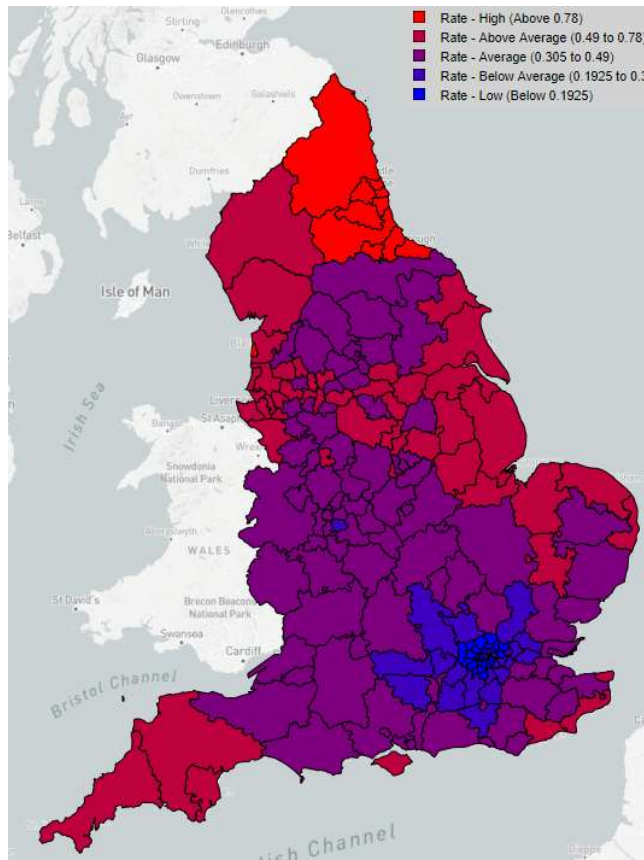


THE ACTUAL DRIVERS OF PRESCRIPTION RATES

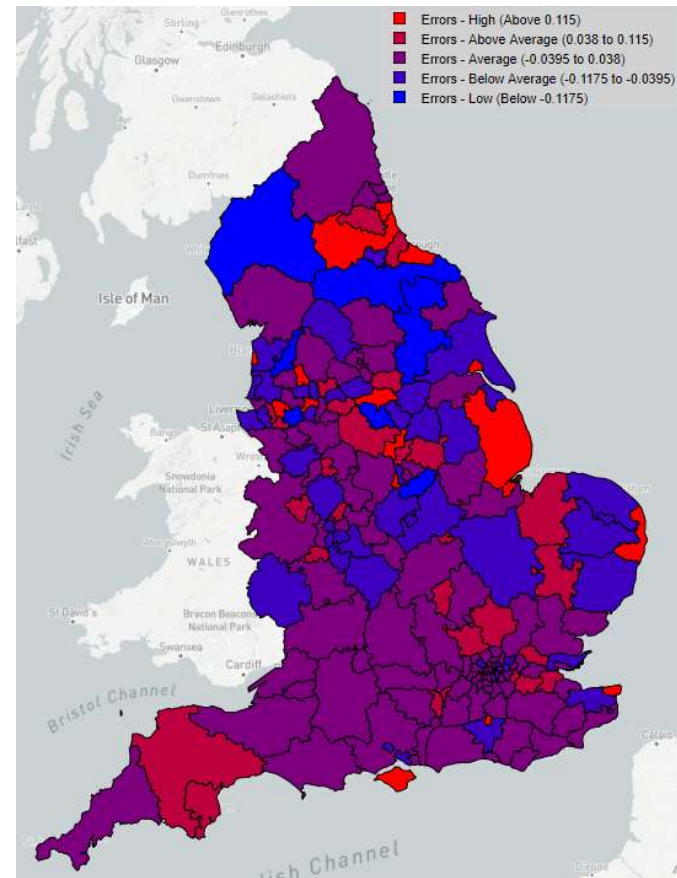
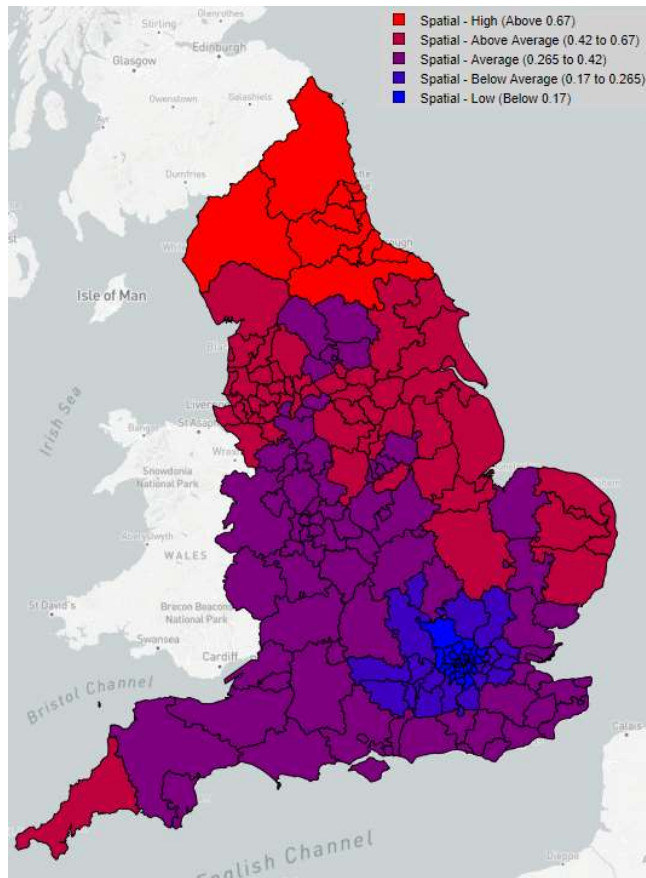
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DECOMPOSING THE EFFECTS



DECOMPOSING THE EFFECTS



RESULT SUMMARY AND IMPLICATIONS

- Result summary
 - There are extremely strong local effects, consistent with local “standards of care”
 - Opioid prescription rates increase with work-age population unemployment and the average age of the population 18 years and over in an area
 - Opioid prescription rates decrease with average disposable income and the percentage of households with children in an area
- Implications
 - Programs that attempt to improve the local “standard of care” with respect to physician opioid prescription behavior in some areas in the country are warranted
 - Developing individual level opioid abuse risk scoring based on economic, household structure, and other factors may well be worthwhile

THANK YOU

<https://github.com/dputler/presentations>

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